AN ASSESSMENT OF THE APPROPRIATENESS TO THE ROYAL AUSTRALIAN AIR FORCE OF A MASTERS LEVEL PROFESSIONAL PROGRAM IN INFORMATION SYSTEMS

THESIS

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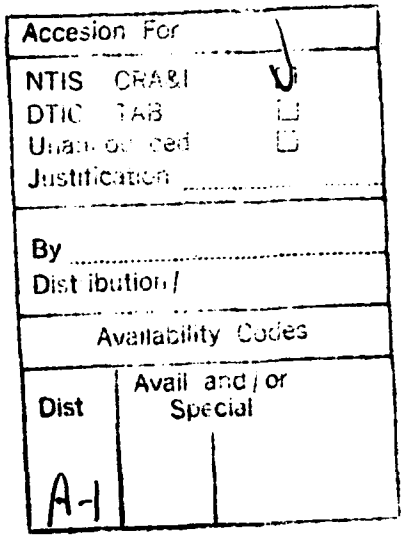

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THESIS

Presented to the Faculty of the
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of the Air Force Institute of Technology
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Preface

The purpose of this research was to assess the appropriateness, to the Royal Australian Air Force (RAAF), of the Association for Computing Machinery's model curriculum in Information Systems (IS) with respect to graduate professional education. Although this research was limited to the incumbents of officer positions in the RAAF's six Information Systems Agencies and the Directorate of Communications and Information Systems - Air Force (DCIS-AF), we hope that its findings are of value in helping DCIS-AF develop a RAAF IS training plan that maximizes the RAAF's return for its training investment.

This is our first major research project and it would not have been possible without the help of several people.

We wish to thank our thesis advisors, Dr. Freda Stohrer and WGCDR Saulius Valciukas for assisting us in designing and executing our research project. In particular, we are grateful for the help, guidance, and encouragement given to us by Dr. Stohrer. Dr. Stohrer's ability to translate our distinctively Australian prose into a research report, together with her willingness to refer us to experts in fields outside her bailiwick, has made our thesis many times better than it might have been.

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Joseph R. Taylor

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Abstract

This study assessed the appropriateness, to the Royal Australian Air Force (RAAF), of a graduate professional program in Information Systems (IS) based on the Association for Computing Machinery's (ACM) model curriculum. The ACM model curriculum is an archetype of graduate education in IS. Programs based on this model produce graduates with knowledge, skills, and abilities (KSAs) that are required by IS practitioners. The usefulness of twenty KSAs that underlie the ACM model curriculum were evaluated by 33 incumbents of officer positions in the RAAF's Information Systems Agencies and the Directorate of Communications and Information Systems - Air Force. Although uncertain about the educational background suited to their job requirements, the respondents found 17 of the KSAs at least somewhat useful, indicating that education based on the ACM model curriculum is appropriate.

Recommendations include: developing a RAAF IS education strategy based on the KSAs, promoting the benefits of IS education, using graduate diplomas in IS as an effective and efficient means of obtaining the necessary KSAs, and examining RAAF sponsored bachelor degrees in IS to ensure that appropriate KSAs are being provided. Future research should identify graduate diploma programs that provide the relevant KSAs presented.

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I. Introduction

General Issue

At present, Royal Australian Air Force (RAAF) officers are recruited against a category (a subset of branch)/branch (e.g., pilot, supply, aeronautical, and administrative), and their first duties are in that area. After initial employment, career management is still based primarily on category, but qualifications and experience are also utilized.

For those information systems (IS) positions not related directly to a particular category/branch, qualifications and experience are used to match officers to positions. In this way, officers are seconded from the General List, General Duties, Engineer, Supply, and Special Duties Branches to positions in IS. So that over-specialization does not limit their career development and potential for promotion, however, officers are employed mostly in positions related to their category. Not surprisingly then, the 1990/94 Air Force Information Systems Master Plan says that the RAAF has a shortage of IS educated

Service and civilian staff employed in IS positions (DCIS-AF, undated a:12).

To address this problem, the RAAF's Personnel Division is creating an IS sub-specialization for officers and airmen (DCIS-AF, undated a:12). So far, only the General Duties Branch (i.e, pilot, airborne electronics, and navigator) has an IS sub-specialization. Pursuant to the 1992 Officer Corps Structure Review, however, IS is one of the four general sub-specializations that the Chief of the Air Staff has accepted (Gration, 1993:1). Nevertheless, "officers will be employed mostly in positions related directly to their specialisation" ["specialisation" will replace the current term "category"] (Gration, 1993:1). So, undergraduate/graduate professional programs in IS will still need to meet the immediate needs of the sub-specialized officers who attend them.

At present, the RAAF "uses Australian universities and overseas military schools to qualify a small number each year to IS undergraduate and Masters degrees" (DCIS-AF, undated a:12). Such qualifications include the United States Air Force Institute of Technology's Master of Science in Information Resource Management. Regardless, the RAAF has not conducted an occupational analysis to obtain a picture of the background of the "typical" incumbent of an officer position in IS; describe his/her job; describe the educational background(s) suited to the job requirements; and define the knowledge, skills, and abilities (KSAs)

required for that job. That is, the RAAF does not know accurately either an individual officer's qualifications and experience or what qualifications and experience are needed to fill a particular IS position.

In 1990, the RAAF conducted the RAAF Officer Computer Sub-specialisation Survey "to enable DPO-AF to assess the current officer computing/IS expertise" (Directorates of Personnel Air Force, 1990:1). In addition, it conducted the RAAF Unit Information Systems-Related Manpower Requirements Survey. In 1991, Officer Cadet Lisa M. Uden was tasked to use the surveys as a basis for a study "to develop an annotations/qualifications matrix for RAAF computing/information systems professionals" (DCIS-AF, undated b:1). When completed, the matrix would allow DPO-AF to better match individuals with positions. Regrettably, "as the accuracy of results cannot be assured the study has been used as a pilot" (Uden, 1991:48).

Specific Problem

The RAAF occasionally sponsors a number of officers to undertake IS courses. One of the hallmarks of the next 10 years will be a greater emphasis on return for training investment (Fookes, 1992:19). This emphasis dictates the need to know which undergraduate/graduate professional programs in IS, at the Bachelor's and Master's levels, seem particularly suitable for RAAF students to undertake. Therefore, one of the thesis topics suggested by the

Directorate of Communications and Information Systems - Air Force (DCIS-AF) was as follows:

> Undertake a census of IS tertiary courses in the USA, at both undergraduate and postgraduate level, with emphasis on emerging trends in the conduct of professional IS education. Highlight courses which seem particularly suitable for RAAF students to undertake, making recommendations concerning the types of employment which should immediately follow such education.

However, in the absence of an occupational analysis, the authors' changed the emphasis of DCIS-AF's thesis topic from a census of available courses in IS to an analysis of occupational characteristics and correlation of those characteristics to a standard IS curriculum. The purpose of this research then, was to assess the appropriateness, to the RAAF, of the Association for Computing Machinery's (ACM's) model curriculum in IS with respect to graduate education. The authors' focus is specifically on master's level programs because the overseas IS courses most utilized by the RAAF are traditionally at that level.

Investigative Questions

The following investigative questions were proffered to solve the specific problem mentioned above:

1. What is the background of the "typical" incumbent of an officer position in a RAAF Information Systems Agency/organization?

2. Which of the three major information systems job categories, namely project manager, systems analyst/designer, and programmer, most accurately

describe(s) the incumbents of officer positions in Information Systems Agencies/organizations jobs?

3. What educational background(s) is/are suited to the incumbents of officer positions in Information System Agencies/organizations job requirements?

4. Which of the 20 specific KSA categories (derived by Cheney, Hale, and Kasper from the recommendations made by the 1982 ACM model curriculum) are important to the incumbents' of officer positions in Information Systems Agencies/organizations jobs?

Answers to these questions provide inferences which are used to solve the specific problem and improve the RAAF's return for training investment on graduate professional programs in IS.

Scope of Research

This research was limited to all the incumbents of officer positions in the RAAF's six Information Systems Agencies (ISAs) and an IS organization, namely: the Directorate of Materiel Management Information Systems, Staff Officer Information Systems - Air Force Office, Staff Officer Personnel and Manpower Information Management, the Directorate of Logistics Information services, Staff Officer Information Systems, and Staff Officer Information Systems - Training Command, and DCIS-AF. An attempt to survey incumbents of officer positions outside the ISAs/DCIS-AF was not warranted because the ISAs/DCIS-AF mirror the population

of jobs which would usually immediately follow a graduate professional program in IS.

Limitations

Two limitations were identified:

1. Nonprobability Sample Selection: Incumbents of officer positions in IS outside the RAAF's ISAs/DCIS-AF were excluded from the survey. However, since the incumbents' of officer positions in the ISAs/DCIS-AF duties vary little from those of graduates of graduate professional programs after course completion, this limitation did not appear to be restricting.

2. Bias/Apathy: The incumbent's thoughts (either favorable or unfavorable) about the need for tertiary IS education in either their position or the RAAF may bias their descriptions of the educational background suited to their job requirements.

Definition of Terms

The following are definitions of keywords that recur throughout the thesis:

1. **Information Systems**. "Information systems are those which are derived from the application of computer and communications technologies to the collection, storage, processing and dissemination of information" (CIS Branch, undated:1).

2. **Knowledge**. "Knowledge refers to the content or technical information needed to perform adequately in a job" (Cheney, Hale, and Kasper, 1990:238).

3. **Skills**. "Skills are the specific psychomotor processes necessary to meet the current requirements of a specific job" (Cheney and others, 1990:238).

4. **Abilities**. "Abilities refer to the cognitive factors that represent present capabilities or achievement levels" (Cheney and others, 1990:238).

5. **Information Systems Agency**. The RAAF's ISAs "are the focal points for computing matters within Air Force Commands, Divisions and projects" (DEFAIR, undated:6).

Overview

Chapter 2 reviews the current literature relevant to the thesis. Chapter 3 describes our methodology. Chapter 4 contains an analysis of the data collected from the incumbents of officer positions in the ISAs/DCIS-AF. Finally, Chapter 5 draws conclusions from the analyzed data to answer the investigative questions, and, hence solve the problem. In addition, recommendations are made about the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate education at the Master's level, and suggestions proffered for further research.

II. Literature Review

Introduction

This literature review describes the role played by the Association for Computing Machinery in the development of model curricula for graduate programs in information systems, the identification and validation of the 1982 ACM model curriculum for graduate IS education (referred to as the ACM model curriculum for the remainder of this thesis) as an archetype for graduate IS education, and the establishment of the authors' method to evaluate the appropriateness of the ACM model curriculum in describing IS education required by RAAF officers.

The first part of the literature review discusses the archetypical strength of the ACM's model curricula in representing IS education, the development of various ACM model curricula, and the validity of the ACM model curriculum as an effective platform for graduate IS education. The second part of the literature review identifies the knowledge, skills, and abilities derived from the ACM model curriculum and establishes the relationship between these KSAs and the ACM model curriculum.

The Association for Computing Machinery

Introduction. The ACM is the oldest educational and scientific computing society in the world (Oz, 1992:424). Founded in 1947, the ACM boasts a membership of 82,000 worldwide and is the largest professional organization in

the information systems industry (Oz, 1992:424). The ACM is involved in all areas of computing related science and education. However, our research investigated only the ACM's work in the area of graduate information systems education curricula.

The ACM is linked to Australia through the Australian Computer Society (ACS). The ACS is a recognized association of 14,000 information technology professionals and has reciprocal agreements with the ACM (ACS, [1992]:1).

The ACM Curriculum Committees. In the late 1960s, the ACM established the Curriculum Committee on Computer Education for Management (C^3EM). The C^3EM was responsible for the development of IS education model curricula for both undergraduate and graduate degrees in IS. The C^3EM developed the first two model curricula: a graduate curriculum in 1972 and an undergraduate curriculum in 1973. Throughout this thesis, the 1972 ACM's C^3EM model curricula for graduate programs in IS is called the C^3EM Curriculum Model or C^3EM Model.

In 1979, the C^3EM was replaced by the ACM Curriculum Committee on Information Systems (C^2IS) (Nunamaker, 1981:124-25). This new curriculum committee reflected the ACM's identification of information systems as a separate discipline. Nunamaker (1981) suggests that "the IS discipline provides the analytical framework and the methodology to analyze, design, implement, and manage complex information systems" (Nunamaker, 1981:125).

Information systems are typically computer technology used by organizations. Organizations initially adopted computer technology to increase their productivity. As competing organizations adopted this technology, the IS function was developed to ensure the organization remained competitive (Clemons and Row, 1991:274-276). These interactions motivated organizations to recognize the importance of the IS function in the late 1970s.

The C^2IS realizing that education needed to reflect the increased importance of the IS function revised the initial C^3EM model curricula. The C^2IS revision of the C^3EM models resulted in the present ACM model curriculum. The present ACM model curriculum covers both undergraduate and graduate programs in IS.

Currency of the ACM Model Curriculum. The C^2IS has not made any changes to the ACM model curriculum since 1982, although, at the ACM's 24th Special Interest Group on Computer Science Education (SIGCSE) Technical Symposium on Computer Science Education held in March 1993, a panel was formed to address IS education issues (SIGCSE, 1993:300). Unfortunately, the findings of this panel will not be finalized until after this thesis research is completed.

Nevertheless, the strength of the ACM's model curricula in IS is their ability to represent education that provides their graduates with the necessary IS skills to become effective IS practitioners. Over time, the ACM's design technique of expert consensus in developing IS model

curricula has been proven. The C^3EM Model remained unchanged for ten years, and when reviewed in 1981, the Model still reflected the core requirements of IS graduates (Nunamaker, 1981:132-133). In 1982, when the C^2IS developed the ACM model curriculum, the C^3EM's list of knowledge and abilities needed by IS graduates was accepted without change (Nunamaker, Couger, and Davis, 1982:785). This list of knowledge and abilities remained unchanged because it covered the requisite skills required by 1980s' IS graduates comprehensively (Nunamaker, Couger, and Davis, 1982:785). During the ten years between the C^3EM Model and the ACM model curriculum, technological advances in IS were considerable. Yet the C^3EM's original listing of knowledge and abilities can comfortably cope with technology of the 1980s. The durability of the ACM model curricula is a result of the ACM's curriculum design technique.

The ACM Curriculum Design Technique. The durability ensured by the ACM's curriculum design technique strongly supports the use of the current ACM model curriculum in this thesis. The ACM curriculum committees design their curricula by obtaining a consensus from a panel of experts (Davis, 1981:15). The panel of experts were typically academics and industry executives who had an active interest in IS education. In addition, the academic experts were experienced in curriculum development and had investigated the education necessary to function effectively in the IS industry (Davis, 1981:15). The 1993 SIGCSE symposium

continued to follow this technique when it formed a panel to address the ongoing needs of IS education (SIGCSE, 1993:300). The ACM's expert consensus technique results in IS curricula that "reflect the leading edge of instructional thinking" (Davis, 1981:16).

The Development of the ACM IS Education Model Curricula

The Framework for the Model Curricula.

Considering IS as a function of an organization and aligning education to meet the requirements of specific jobs has been used by all ACM IS curriculum committees. In 1971, the C^3EM produced a position paper that outlined a framework that would support the development of a model curriculum for IS. The paper analyzed the role of IS in organizations, what was expected of personnel who worked in IS, and the roles the personnel performed (Teichroew, 1971:574-580). Organizations can be defined as any enterprise that carries out activities. This definition includes private and public enterprises, as well as government agencies (Teichroew, 1971:574). The C^3EM used its committee members' expertise to determine the current and future state of IS in organizations.

Perceived Deficiencies.

The Teichroew (1971) paper recognized that IS practitioners in organizations not only deal with the technical side of computing, but also must deal with the organizational aspects of an enterprise (Teichroew, 1971:574). These organizational aspects include planning, control, development, and integration of IS into

the structure of the organization (Teichroew, 1971:574). The C^{3}EM's analysis identified the following three critical deficiencies of the IS function in organizations:

1. personnel were inadequately qualified,
2. communications between computing staff and management often broke down, and
3. IS subject matter was presented in a form unsuitable for education (Teichroew, 1971:579-580).

Identifying the Need for IS Education. The C^{3}EM analysis identified a lack of appropriate IS education for personnel employed in IS in organizations (Teichroew, 1971:574) and proposed the development of education and curricula for IS in organizations (Teichroew, 1971:580-584). Three IS job specializations were identified by the C^{3}EM:

- **Information Analyst**. An information analyst specifies what functions a system will perform and is user oriented.
- **Systems Designer**. The systems designer decides how to implement the system and is technology oriented.
- **Programmer**. The programmer develops and tests parts of the system and is oriented towards the software and hardware tools used. (Teichroew, 1971:576)

In addition, the need for qualified teachers and researchers in IS should be met by the education proposed by the C^{3}EM. Therefore, the development of a professional program such as a master's degree was needed (Teichroew, 1971:574).

The C^3EM Graduate Education Model Curricula

The C^3EM Model has been proven over time as an accurate archetype of graduate IS education. Nunamaker and others (1982) found that the C^3EM Model has "been influential in the development of degree programs at the bachelor's, master's, and doctoral levels" (Nunamaker, Couger, and Davis, 1982:781). The strength of the C^3EM Model is directly attributable to the ACM curriculum design technique of consensus among specific IS education experts. The factors that underlie the development of the C^3EM Model also forged a solid foundation for the 1982 ACM model curriculum.

From the 1971 C^3EM framework, the C^3EM published two models: a curriculum for IS graduate programs in 1972; followed in 1973, by a curriculum for IS undergraduate programs (Ashenhurst, 1972:363-393; Couger, 1973:727-739).

The C^3EM Model aimed to provide an educational basis from which a graduate could advance from entry-level positions to higher levels of IS management (Ashenhurst, 1972:368). To achieve this aim, the C^3EM analyzed the skills that were required: 1) to effectively fulfill the entry level IS positions and 2) to provide a basis for career growth. From their analysis, the C^3EM formulated a list of knowledge and abilities (Ashenhurst, 1972:370). Two entry-level positions were identified in the C^3EM Model: an information analyst who is a user-oriented practitioner, and a systems designer who is a technology-oriented practitioner (Ashenhurst, 1972:368). From the list of knowledge and

abilities, the C^3EM outlined the courses that make up the graduate IS curriculum model (Ashenhurst, 1972:372).

The C^3EM described the development of IS in organizations as consisting of "an iterated process of information analysis, systems design, and implementation" (Ashenhurst, 1972:367). The information analysis and systems design components are the actual developmental functions. Information analysis determines user requirements and systems design is concerned with how to best accomplish these requirements (Ashenhurst, 1972:367; Teichroew, 1971:576). The two functions of information analysis and systems design portray the activities performed by the two entry-level IS positions described in the C^3EM Model, namely: information analyst and systems designer (Ashenhurst, 1972:368-369).

The Validity of the C^3EM Model. The C^3EM Model remained valid after ten years despite changes in technology. The curriculum design technique of the C^3EM Model ensured that the model's validity would remain intact over time. The design technique was forward looking rather than merely embracing the current perceived requirements of the IS industry at the time. The benefit of focusing on the future needs is the temporal strength of the resulting curriculum model. Temporal strength is the ability of the curriculum model to remain relevant over time, in spite of technological advances and other changes. In 1982, when the C^3EM Model was being replaced by the ACM model curriculum,

Nunamaker and others commented that "the basic structure ...[of the C^3EM Model]...has remained intact" (Nunamaker, Couger, and Davis, 1982:782).

Empirical proof of the effectiveness of the ACM committee approach to the development of curricula is contained in the 1974 Working Paper of the Management Information Systems Research Center (MISRC) at the University of Minnesota. The MISRC sought to validate the assumptions and recommendations of the C^3EM Model by surveying IS practitioners (Henry, Dickson, and LaSalle, 1974:3). Nine hundred and eighty-one subjects were empirically surveyed to determine the specific IS skills required (Henry, Dickson, and LaSalle, 1974:1-4). The researchers found that the C^3EM Model adequately addressed a wide range of IS environments and recommended that "centers implementing the ACM recommendations must become centers of excellence in educating practitioners" (Henry, Dickson, and LaSalle, 1974:23-24). The findings of the 1974 MISRC research demonstrates the effectiveness of using a committee of experts to design an IS curriculum model.

The 1981 IS Education Status Report. The 1981 C^2IS report reviewed the C^3EM Model and recommended it be upgraded. The C^2IS, after reviewing the status of IS education in the United States, identified certain changes to improve the C^3EM Model (Nunamaker, 1981:133). Specifically, the C^2IS reported that IS programs needed to cover both technical and organizational knowledge

(Nunamaker, 1981:124). The C^2IS tested 124 IS programs for compliance with the C^3EM Model (Nunamaker, 1981:132). Most of the IS programs did not fully comply with the C^3EM recommendations. However, 87 programs did meet a "minimum common core" of recommendations (Nunamaker, 1981:132-133). The "minimum common core" consisted of five courses in technical subjects and four courses in organizational subjects. Although a common core of IS education was present, there were many variations between programs. The C^2IS research suggested that a successful IS practitioner should possess a balance of organizational and technical skills and this should be reflected in an IS curriculum (Nunamaker, 1981:126).

The ACM Model Curriculum

The ACM model curriculum aims to describe a program capable of preparing a graduate to successfully fulfil the positions of either systems analyst, programmer/analyst, or IS specialist. The model is structured to satisfy the C^2IS's 1981 observation, that a successful IS practitioner should possess a balance of organizational and technical skills (Nunamaker, 1981:126). For example, an IS practitioner possessing both organizational and technical skills is more productive in the organization, than a solely technical practitioner. The C^2IS recognized that IS education should be improved to meet the demand for increased organizational productivity (Nunamaker, Couger,

and Davis, 1982:783). The improved education will prepare new graduates for the challenges created by the increasing complexity of the IS systems used in organizations (Nunamaker, Couger, and Davis, 1982:783). The increase in complexity is caused by a combination of technical advances in information technology and the interactions of this information technology on the organization. To reflect advances in the field, the C^2IS revised and updated the C^3EM Model by:

1. integrating management skills into courses,
2. including data management and data communication courses,
3. including the American Assembly of Collegiate Schools of Business (AACSB) common body of knowledge, and
4. adding a Management Information Systems (MIS) policy course as a capstone to the program (Nunamaker, Couger, and Davis, 1982:783).

The ACM model curriculum was designed on the philosophy that the graduate of the IS program will be employed in positions that involve organizational IS. This model produces:

- **Systems Analysts.** A systems analyst defines information requirements and develops system designs for an IS.
- **Programmer/Analysts.** A programmer/analyst produces computer programs that comprise an IS.
- **IS Specialists.** An IS specialist plans, administers and manages an information systems. (Nunamaker, Couger, and Davis, 1982:785)

ACM Model Curriculum Structure. The ACM model curriculum outlines the knowledge and abilities needed to work effectively in IS (Nunamaker, Couger, and Davis, 1982:785). Importantly, these outlined knowledge and abilities are capable of being taught and tested in the academic environment, and therefore form the basis of the courses described in the ACM model curriculum (Nunamaker, Couger, and Davis, 1982:786). The ACM model curriculum consists of five technical courses and five organizational courses, thus providing a balance between organizational and technical skills (Nunamaker, Couger, and Davis, 1982:786). The model has six slots that are available to satisfy individual degree or program requirements. For example, in a Master of Science, the university may require a thesis and allocate appropriate time slots for prerequisite courses and research. The ACM Graduate IS Model Curriculum is depicted at Figure 1.

Sole Representative of Graduate IS Education. Graduate IS education is the bailiwick of the ACM's C^2IS. Other models describe various types of computer-related education, but do not address graduate IS education. Goulet, Morris, and Staal (1982) reviewed five model curricula for computer education: the ACM Curriculum '78, IEEE's "A Curriculum in Computer Science and Engineering", CUPMs "Report of Subpanel (sic) on Computer Science", DPMAs "Model Curriculum", and the Pittsburgh Large User Group Education Committee's "Data Processing (DP) Curriculum" (Goulet, Morris, and Staal,

Term	IS Courses (1 to 10) Offered in Sequence			
I	IS_1 Computer Systems Concepts	IS_2 Program, Data and File Structures	IS_3 Systems and Information Concepts in Organizations	
II	IS_4 Data Management	IS_5 Information Analysis		
III	IS_6 Data Communication Networks And Distributed Processing	IS_7 Modeling and Decision Systems	IS_8 Systems Design	
IV	IS_9 MIS Policy	IS_{10} Systems Development Projects		

Figure 1. The ACM Graduate IS Model Curriculum
(The program is a 48 credit hour masters containing six shaded areas that are open for other MS requirements.)
(Nunamaker, Couger, and Davis, 1982:789)

1982:46). The first three curricula are computer science curricula. Computer science programs emphasize computer technology as a problem-solving tool for performing computational activities (Forgionne, 1992:143-144).

The Data Processing Management Association's (DPMA) Model Curriculum and the Pittsburgh Large User Group Education Committee's DP Curriculum are model curricula for undergraduate IS education. IS programs study how computers can be used within organizations (Forgionne, 1992:143-144). The DPMA Model Curriculum focuses on preparing graduates to use, evaluate, and manage IS while pursuing a career in IS.

On the other hand, the Pittsburgh Large User Group Education Committee's Model DP Curriculum responded to the shortage (at the time) of trained IS practitioners and prepared graduates to meet the direct needs of the business community (Goulet, Morris, and Staal, 1982:46). Both models focused on undergraduate IS education and did not address curricula for graduate education. The DPMA continues to influence undergraduate IS programs and maintains a current Model Curriculum (Forgionne, 1992:143). A notable omission in the research by Goulet, Morris and Staal was the ACM's C^3EM Model.

Usefulness of the ACM Model Curriculum. The ACM model curriculum has a structure that allows the courses' educational content to reflect current thinking. The ACM model curriculum supports IS graduate programs that update their courses to keep in touch with the changing needs of IS practitioners and technology. The ACM model curriculum's ability to satisfy changing needs of IS practitioners makes the model a powerful tool for designing graduate programs in IS.

Course Curricula Research. The ACM model curriculum is capable of accommodating changes to programs by incorporating course-level recommendations within its current structure. Research resulting in course-level recommendations does not need to specifically address the ACM model curriculum. The research may deliver broad improvements in graduate IS courses and cognizance of the

improvements can be undertaken within the ACM model curriculum.

Two recent studies have evaluated graduate-level courses and recommended improvements. These studies matched graduate IS course curricula to the needs of the IS practitioner and determined areas for improvement. Each of the studies evaluated a single information systems graduate course. The graduate courses from these studies were:

1. **Management Information Systems Course.** The management information systems course was researched by Gupta and Seeborg (1989). The MIS course is a required course by the AACSB (Gupta and Seeborg, 1989:126). The ACM model curriculum contains the AACSB common body of knowledge.

2. **Information Resource Management Course.** The information resource management (IRM) course was researched by Laribee (1991 and 1992). IRM is considered to be a part of the MIS discipline (Laribee, 1991:16).

In both cases, the researchers investigated the structure of the respective courses in terms of meeting the needs of IS practitioners, and recommended changing the content and the manner in which the courses were taught. These changes could be made without altering the structure of the ACM model curriculum.

The ACM model curriculum depicts a graduate IS program with ten graduate IS courses. The content or method of instruction of any given course within the ACM model

curriculum could be changed without eliminating that course from the basic ACM curriculum. This capability of the ACM model curriculum, in fact, allows the educational content within courses to reflect current thinking and meet the needs of IS practitioners.

Characterization of the IS Positions

If the ACM model curriculum is to be useful in designing effective graduate programs in IS, the three positions output by the ACM model curriculum (systems analyst, programmer/analyst, and IS specialist) must be relevant to the IS industry. Therefore, the appropriateness of the positions underlying the ACM model curriculum will be examined.

The IS work force includes a wide cross-section of individuals performing a broad range of tasks (Crepeau and others, 1992:152). Most researchers (ACM, DPMA, MISRC and others) describe the IS work force by job category. A job category is normally depicted by a list of task descriptions. The characterization of IS positions for the purposes of researching IS graduate education has generally been based on entry level positions (Nunamaker, Couger, and Davis, 1982:784).

IS Positions Identified by Other Research. Other researchers have categorized IS positions consistent with those of the ACM. Crepeau and others (1992) in researching IS career structures identified four IS positions: computer

operator, programmer, systems analyst, and manager (Crepeau and others, 1992:152). The Crepeau led research covered the entire IS community. Nevertheless, programmer and systems analyst positions identified by Crepeau and others reflects the ACM model curriculum's programmer/analyst and systems analyst. Similarly, the ACM model curriculum's IS positions are mirrored in a group of studies performed by Cheney and others where programmer, systems analyst/designer, and project manager were identified (Cheney, Hale, and Kasper, 1990:240). The project manager is comparable to the ACM model curriculum's IS specialist:

- **Project Manager**. A project manager coordinates and allocates resources to working information systems in accordance with set specifications. (Cheney, Hale, and Kasper, 1990:240)
- **IS Specialist**. An IS specialist plans, administers and manages an information systems. (Nunamaker, Couger and Davis, 1982:785)

In a broad survey of 334 IS practitioners undertaken by Datamation magazine in 1989, the major IS positions (such as programmer and systems analyst) described were similar to those characterized by Crepeau and others, and Cheney and others (Carlyle, 1989:30). The Datamation survey also identified IS specialist areas such as database management, data communications, and telecommunications. The positions described by the ACM model curriculum were present in the Datamation survey.

Richards and Sanford's survey of recent IS graduates from the University of North Texas (UNT) described three IS

positions: "an IS professional creating software, a sophisticated user of computing technology and a sophisticated facilitator of user(s)" (Richards and Sanford, 1992:223). These positions easily correlate to the three IS positions characterized by the ACM model curriculum:

ACM	Richards and Sanford
Programmer	An IS professional creating software
IS Specialist	A sophisticated user of computing technology
Systems Analyst	A sophisticated facilitator of user(s)

The similarity between the IS entry-level positions underlying the ACM model curriculum and the actual IS positions identified and categorized by Crepeau and others, and Cheney and others., Datamation, and Richards and Sanford reinforces the usefulness of the ACM model curriculum in designing graduate programs in IS.

Advanced IS Positions. A graduate IS curriculum should provide the educational foundation for progression to advanced positions in IS. Cheney and Lyons (1980) recognized that incumbents in IS positions may require different skills as their careers progress. Their research identified three IS positions: systems analyst, programmer and data center manager (Cheney and Lyons, 1980:38). The data center manager represented another step in the IS career field, beyond the entry level positions postulated by the ACM model curriculum. The data center manager requires a better understanding of management and business practices (Cheney and Lyons, 1980:40). In another Cheney led study,

the data center manager was replaced by another advanced-level position, the project manager (Cheney, Hale, and Kasper, 1990:240). The project manager has a charter broader than that of the data center manager, but still requires a thorough understanding of management and business practices. The MISRC recognized that IS practitioners with one to three years specialty experience may require further education to develop these managerial skills (Henry, Dickson, and LaSalle, 1974:24). A possible mechanism to obtain managerial or advanced IS skills is by undertaking a graduate program in IS.

The ACM model curriculum aims to produce a graduate that can fulfil an entry level position, as well as provide "a basis for continued career growth" (Nunamaker, Couger, and Davis, 1982:784). As the research in this thesis is focused on the appropriateness of graduate education to RAAF officers in various stages of their careers, this literature review should determine whether the ACM model curriculum can prepare graduates for advanced IS positions in organizations. To evaluate the link between the ACM model curriculum and IS positions, further analysis of the IS skills developed by the ACM model curriculum and the establishment of a method to test the appropriateness of these skills to the RAAF is required.

Application of the ACM Model Curriculum

The first part of the literature review discussed the

development of model curricula for graduate programs in information systems, and identified and validated the ACM model curriculum as an archetype for graduate IS education. Identifying and validating the ACM model curriculum demonstrates that the Model provides an acceptable platform on which to base graduate professional programs in IS for RAAF officers.

The second part of the literature review identifies the knowledge, skills, and abilities derived from the ACM model curriculum and establishes the relationship between these KSAs and the ACM model curriculum.

Description of the Cheney Led Studies. A series of studies led by Paul H. Cheney (1980 and 1990) aimed to provide "information and direction regarding the skills needed by current and future IS professionals" (Cheney, Hale, and Kasper, 1990:237). These studies provided information and direction by evaluating IS skills that are needed by IS practitioners to effectively perform their jobs. To perform their research, Cheney and others derived their IS skill areas from the ACM's list of knowledge and abilities which underlies the C^3EM Model and the ACM model curriculum (Cheney, Hale, and Kasper, 1990:240; Ashenhurst, 1972:370; Nunamaker, Couger, and Davis, 1982:785). The original 36 IS skills suggested by the ACM were refined to 26 IS skills and reported in Cheney and Lyons (1980). The 26 IS skills were further reduced to 20 knowledge, skills, and abilities (KSAs) in the Cheney, Hale, and Kasper (1990)

report (Cheney, Hale, and Kasper, 1990:240). The redefinition process will be discussed later.

In 1978, Cheney and Lyons (1980) interviewed IS managers from 32 organizations (Cheney and Lyons, 1980:35). At these interviews, IS managers, based on their perceptions, evaluated the usefulness of 26 IS skills across three IS worker positions (Cheney and Lyons, 1980:38-39). The three positions representative of entry and advanced levels were:

- **Data Center Manager**. The data center manager supervises systems development staff and operations staff.
- **Systems Analyst**. The systems analyst defines user needs and designs systems to meet these needs.
- **Programmer**. The programmer develops programs from the system requirements. (Cheney and Lyons, 1980:38)

In 1987 and 1988, Cheney and others interviewed 56 and 79 IS executives, respectively (Cheney, Hale, and Kasper, 1990:239). At the interviews, 20 KSAs were evaluated across three IS worker positions: project manager, systems analyst/designer, and programmer again representative of graduate education (Cheney, Hale, and Kasper, 1990:240). From the 1978 survey, the number of IS skills (now called KSAs) were reduced to reflect technology changes over the intervening period and the ACM model curriculum. The IS worker position of data center manager was replaced by the project manager position. The project manager coordinates and allocates resources to working information systems in

accordance with set specifications (Cheney, Hale, and Kasper, 1990:240).

Results of the Cheney Led Studies. Cheney, Hale, and Kasper (1990) found that "the interview responses support many of the KSAs recommended in [the] 1982" ACM model curriculum (Cheney, Hale, and Kasper, 1990:245). This finding reflected the earlier Cheney and Lyons (1980) study that achieved similar results with the 26 IS skills being generally applicable across all three IS positions.

There was some variance in the degree of usefulness of certain IS skills to certain IS positions. For example, the data center managers had different needs from the systems analysts and programmers. Overall, both Cheney led studies found that the KSAs (and earlier IS skills) satisfied the professional needs of the different IS positions (Cheney and Lyons, 1980:40-43; Cheney, Hale, and Kasper, 1990:245).

Importance of IS Skills. Graduate IS education is focused on producing the KSAs needed by IS practitioners to work effectively in organizations. Awareness of what KSAs are needed by practitioners is crucial in evaluating the appropriateness of graduate education in IS. In the Cheney-led studies, KSAs were successfully linked to IS worker positions. In fact, Cheney and others (1990) state that the information gleaned from their study can be used by educators and managers "to ensure that students have skills needed to meet the expected challenges of tomorrow's work environment" (Cheney, Hale, and Kasper, 1990:238). Thus,

the KSAs identified in the Cheney-led studies could be used to evaluate the appropriateness of the education provided by the ACM model curriculum for the respective IS worker positions. To accomplish this evaluation, the IS skills describing the IS worker positions have to be comparable to the output IS skills of an education program.

The Source and Development of IS Skills

As mentioned previously, the 26 IS skills and 20 KSAs evaluated in the Cheney-led research were developed from the knowledge and abilities used by the ACM to develop their IS education curricula models.

The 26 IS skills evaluated in 1980 reflect IS skills output by the C^3EM model curriculum. The IS skills in Cheney and Lyons' survey were developed from the C^3EM's list of knowledge and abilities needed to work effectively in IS (Cheney, Hale, and Kasper, 1990:240; Ashenhurst, 1972:370). The 26 IS skills were refined by a panel of five academics from an original 36 skills based on the major topics in the C^3EM's list (Cheney, Hale and Kasper, 1990:240).

Introduction of KSAs. The 1990 study introduced the concept of knowledge, skills, and abilities KSAs to replace the term "IS skills" used in the 1980 research. KSAs are attributes of an incumbent required by a job for "effective performance of tasks or duties" (Cheney, Hale and Kasper, 1990:238). The 26 IS skills were reduced to 20 KSAs in the 1990 research based on the ACM model curriculum, reflecting

a reduction in the role of quantitative management in IS (Cheney, Hale, and Kasper, 1990:240).

Identifying the KSAs with the ACM Model Curriculum. The 20 KSAs represent the knowledge, skills, and abilities that should be possessed by a graduate of an IS program based on the ACM model curriculum. Between the Cheney and Lyons (1980), and the Cheney, Hale, and Kasper study (1990), the ACM revised its curriculum model for IS education and in 1982 produced the ACM model curriculum. Consequently, the 1990 Cheney-led study continued to rely on the ACM as a source of IS knowledge and abilities information. Thus, the ACM model curriculum became the source for providing KSA information to the 1990 Cheney-led study. The KSAs are strongly bonded to the ACM model curriculum and represent the IS skills output by the ACM model curriculum.

To assess the appropriateness of a graduate program in IS based on the ACM model curriculum (at Master's level), IS practitioners can rate the degree of usefulness of each KSA to their job. If the degree of usefulness is high, then the ACM model curriculum should provide the appropriate graduate education for these IS practitioners. If the degree of usefulness is low, then graduate IS education in accordance with the ACM model curriculum would not be appropriate for these IS practitioners.

Our Research Using the KSAs

The direct relationship between the KSAs and the ACM

model curriculum provides a framework for evaluating the appropriateness of the ACM model curriculum in meeting the needs of the incumbents of officer positions in RAAF IS. The incumbents of officer positions in the RAAF's Information Systems Agencies/Directorate of Communication and Information Systems - Air Force, using the survey developed by the authors in Chapter 3, rated the degree of usefulness of the 20 KSAs to determine if the ACM model curriculum is appropriate to their current positions. This method, without performing an occupational analysis, identifies the knowledge, skills, and abilities needed by RAAF officers in IS positions to effectively perform their jobs. The authors use these identified knowledge, skills, and abilities to assess the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate professional education at the Master's level. For the study, the officers categorized themselves into the three IS worker positions as depicted by Cheney, Hale, and Kasper.

The authors, having settled on a method for investigating the problem statement, sought to authenticate their method by comparing it to existing literature. A model was found that describes a methodology that modifies or reviews educational curricula to meet the needs of an identified collective body. The model was developed by Goulet, Morris, and Staal (1982) and is called the Creative Mixer Model. Figure 2 shows the structure of the model.

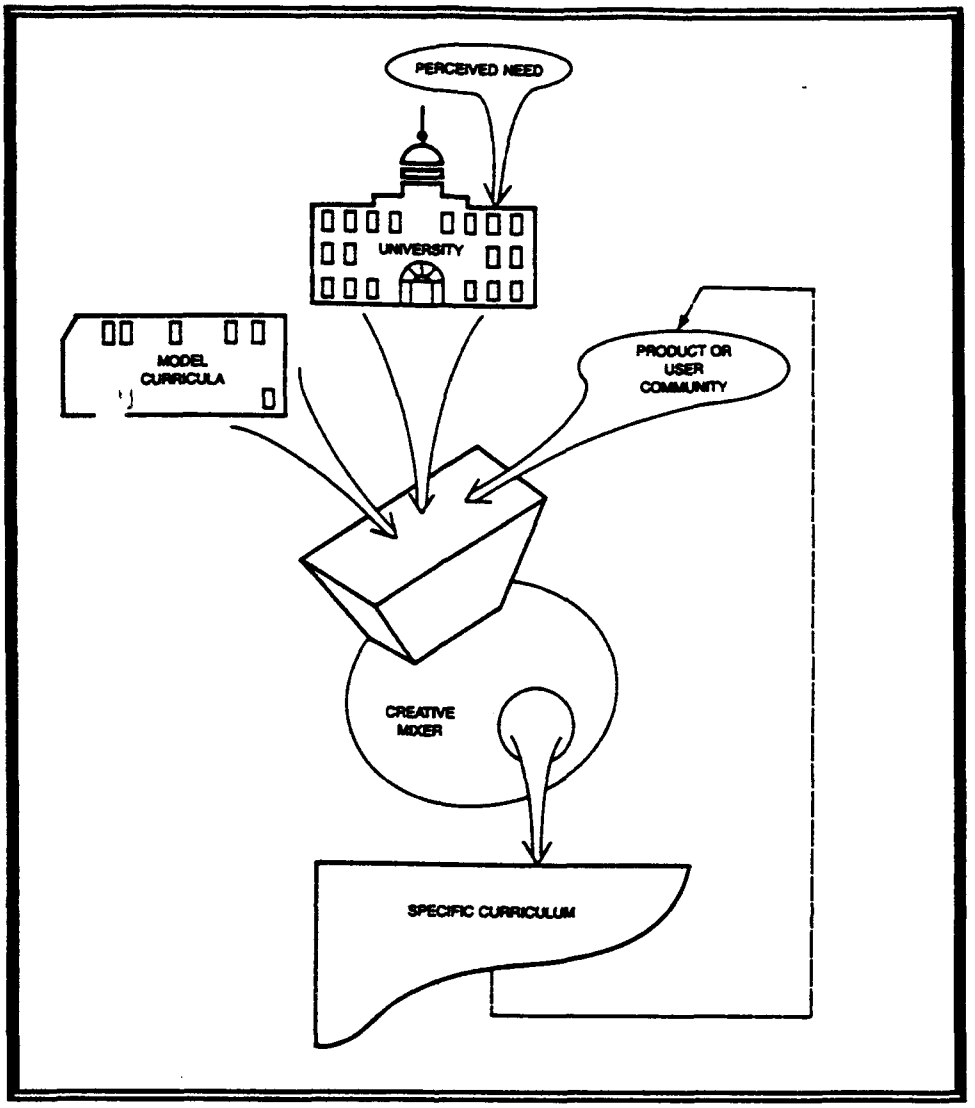

Figure 2. Creative Mixer Model.
(Goulet, Morris, and Staal, 1982:45)

A Comparison with the Creative Mixer Model. Goulet, Morris, and Staal's (1982) Creative Mixer Model was designed primarily for educational institutions to identify and develop specific curricula for their particular target market (Goulet, Morris, and Staal, 1982:44). However, each component of the Creative Mixer Model could be applied to this thesis and the RAAF IS situation.

The Creative Mixer Model is comparable to the method developed by the authors in this literature review to examine the needs of an organization and to produce a certain product. In both methodologies, the most important link is the use of a model curriculum on which to base the analysis or research. Interestingly, the Creative Mixer Model can be used to evaluate curricula as well as to produce a specific curriculum. Goulet, Morris, and Staal state that the Creative Mixer Model allows for a "systematic analysis and evaluation [of the external and] educational environment to assist in producing [or evaluating appropriate] curricula" (Goulet, Morris, and Staal, 1982:50).

Adapting the Model. The model could be adapted to represent any organization looking to define and design specific curricula for its IS employees. The processes in the model would be identical. Figure 3 shows the authors' adaption of the model to reflect their methodology. The model can apply graduate IS education to RAAF officers in IS positions. The details of the Model's components adapted by the authors to the RAAF situation are:

- **Perceived need.** The RAAF needs officers who are knowledgeable about IS and can provide expertise to the total organization.
- **Model Curriculum.** The ACM model curriculum represents a certain perspective of IS education. This perspective is evaluated as meeting the requirements of the RAAF.
- **Product/User Community.** The RAAF's user community/organizations are the Information

Systems Agencies/organizations who desire IS graduates with the skills needed to perform the tasks in the IS environment.

- **Creative Mixer**. This thesis will perform the role of the creative mixer, to assess the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate professional education at the Master's level. The basis for the creative mixer is the relationship between the KSAs and the ACM model curriculum.

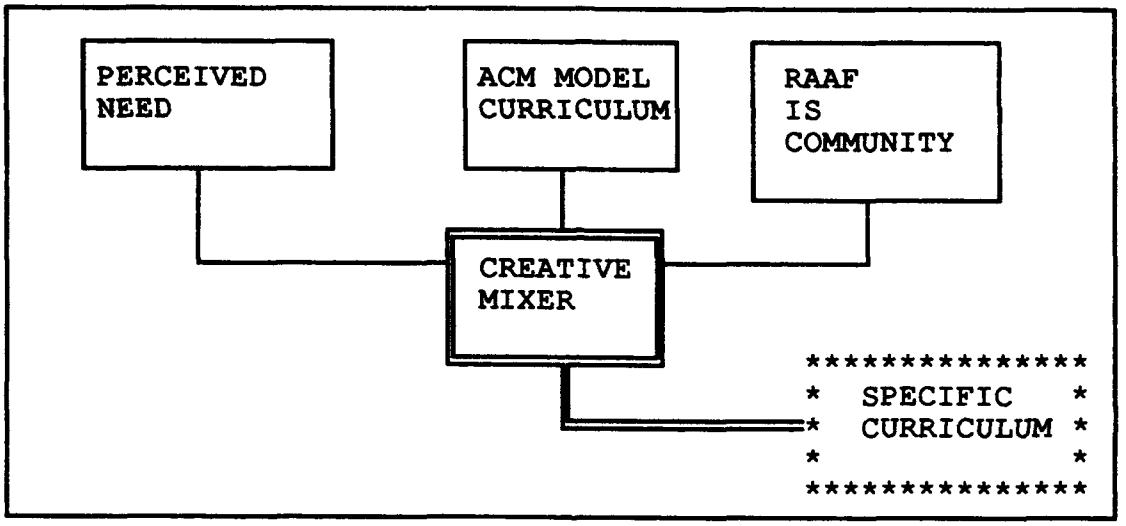

Figure 3. An Adaption of the Creative Mixer Model Reflecting the Thesis Methodology

Summary

In this literature review, the ACM model curriculum was identified and validated as an archetype for graduate programs in IS. The ACM curriculum design technique uses the consensus of experts to produce durable, relevant model curricula. This design process provides the leading edge of instructional thinking. The ACM model curriculum accommodates new technology by changing the contents of its

courses rather than supporting obsolete programs. The aim of the ACM model curriculum is to produce graduates with specific knowledge, skills and abilities through the courses offered.

In research by Cheney and others (1980 and 1990), 20 KSAs are used to represent the knowledge, skills, and abilities of the ACM model curriculum. The authors will use the KSAs to assess the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate professional education at the Master's level. The authors' method of using a curriculum model as a basis to evaluate education requirements is similar to the methodology depicted in the Goulet, Morris, and Staal's Creative Mixer Model.

III. Methodology

Introduction

As stated in Chapter 1, the purpose of this research was to assess the appropriateness, to the Royal Australian Air Force, of the Association for Computing Machinery's model curriculum in Information Systems with respect to graduate education at the Master's level. The following is an explanation of the two-part method used in the problem solving process. The first part includes information on the development of the authors' methodology, identification of an accepted model curriculum for graduate professional programs in IS, and derivation and testing of the knowledge, skills, and abilities derived from that program. The second part covers the method by which the data was collected, how it was organized, and which data analyses have been performed.

Methodology Development

So far, the RAAF has not undertaken an occupational analysis to obtain a picture of the background of the "typical" incumbent of an officer position in IS; describe his/her job; describe the educational background(s) suited to their job requirements; and define the KSAs, and abilities required for that job. The authors therefore redirected the emphasis of the thesis topic suggested by the Directorate of Communications and Information Systems - Air Force to attempt to assess the appropriateness, to the RAAF,

of a graduate professional program in IS, at the Master's level, based on the importance of the KSA categories derived from the program/curriculum to the incumbents of officer positions in the Information Systems Agencies/DCIS-AF.

To this end, the authors:

1. Carried out a comprehensive review of what is already known about graduate professional programs in IS, at the Master's level.

2. Identified and justified the selection of an accepted model curriculum for graduate professional programs in IS.

3. Identified the KSAs derived from the ACM model curriculum recommendations.

4. Asked the incumbents of officer positions in the ISAs/DCIS-AF to indicate the degree of usefulness, in their present jobs, of each of the KSA categories.

5. Analyzed the data.

Accepted Model Curriculum for Graduate Professional Programs in IS

The accepted model curriculum for graduate professional programs in IS identified for the authors' study--"Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs"--was published in 1982 by the ACM Curriculum Committee on Information Systems with Jay F. Nunamaker, J. Daniel Couger, and Gordon B. Davis as editors.

The ACM. Founded in 1947, the ACM "develop[s] and maintain[s] the integrity and competence of individuals in the field" of information processing (ACM, 1993:7).

Curriculum Recommendations by the ACM. The need for an IS curriculum was first outlined in the position paper "Education Related to the Use of Computers in Organizations" by the ACM Curriculum Committee on Computer Education for Management in 1971. The C^3EM and its successor the C^2IS' efforts over the next 10 years resulted in the publication of the: "Curriculum Recommendations for Graduate Professional Programs in Information Systems" by the C^3EM in 1972, "Curriculum Recommendations for Undergraduate Studies in Information Systems" by the C^3EM in 1973, and "Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs" by the C^2IS in 1982 (Nunamaker, Couger, and Davis, 1982:782).

Curriculum Guidelines Implementation. During the period June 1977–June 1979 "the C^2IS surveyed information systems programs to determine how well the curriculum guidelines ... [established by the C^3EM in 1972 and 1973] have been implemented" (Nunamaker, 1981:130). The results of the survey "indicated that only 53 [of 70] undergraduate and 34 [of 54] graduate programs satisfied the minimum criteria for classification as an information systems program based on the ACM curriculum" (Nunamaker, 1981:132).

IS Curriculum Recommendations. After the C^2IS completed the survey of IS programs, it "revised and updated

[the curriculum recommendations of the C³EM] based on advances in the field" (Nunamaker and others, 1982:781). The revised and updated curriculum recommendations were published in 1982 by the C²IS.

The ACM Model Curriculum. The curriculum recommendations of the C³EM "have been influential in the development of degree programs at the bachelor's, master's, and doctoral levels" (Nunamaker and others, 1982:781). In addition, in spite of being updated based on advances in the field, "the basic structure ... has remained intact" (Nunamaker and others, 782:1982). Thus it appears that curriculum recommendations made by the ACM are both accepted and enduring.

While the ACM model curriculum describes both bachelor's and master's level programs, the authors' focus is on master's level programs because the overseas IS courses most often utilized by the RAAF are traditionally at that level.

KSA Derivation and Testing

The 20 KSAs identified for the authors' questionnaire were derived by Cheney, Hale, and Kasper from the recommendations made by the ACM model curriculum. Cheney and others tested the appropriateness of these skills for a graduate IS curriculum by having 135 senior IS managers from a diverse set of industries (e.g., manufacturing, government, and banking/insurance) evaluate them in the

structured interviews conducted by Cheney and others in 1987 and 1988. Senior IS managers rated the importance of these categories to the three major information systems job categories, namely project manager, systems analyst/designer, and programmer. The scale used was numbered 1 to 5, where 1 was "Not Useful" and 5 was "Essential" (Cheney, Hale, and Kasper, 1990:239-240). "The interview responses support many of the KSAs recommended in [the] 1982" ACM model curriculum (Cheney and others, 1990:245). Thus it appears that the KSAs derived from the ACM model curriculum are perceived by the practitioners as those needed by IS workers.

This allowed the authors to assess the appropriateness, to the RAAF, of a graduate professional program in IS, at the Master's level, based on the importance of the KSA categories derived from the ACM model curriculum to the incumbents of officer positions in the ISAs/DCIS-AF.

Explanation of the Questionnaire Method

This part of the methodology includes information on the population under study, and the nonprobability sample to be taken. It also covers the data collection plan, and what data analyses have been performed.

Mail Questionnaire. The authors used a mail questionnaire to gather information for the investigation inasmuch as all of the respondents are located in Australia, and so were difficult to reach in any other way.

Population

The population of study in this project was composed of all the incumbents of officer positions in RAAF IS.

Nonprobability Sample

The authors "use[d] nonprobability sampling because such a procedure satisfactorily ... [met] the sampling objectives" (Emory and Cooper, 1991:273).

A judgement sample, which is a type of purposive sample (Emory and Cooper, 1991:275), was taken from the population. First, the required criterion for membership in the population was selected based on the sampling objectives. The criterion selected was as follows: any incumbent of an officer position in an ISA/DCIS-AF. The criterion was selected to provide a population which mirrors the population of types of jobs which would ordinarily immediately follow a graduate professional program in IS. Once the appropriate criterion was selected, 65 incumbents of officer positions in the ISAs and DCIS-AF were surveyed.

Questionnaire Development and Testing

The questionnaire (displayed at Appendix A) was divided into three parts. The first part requested background information on the respondents. The demographic data included rank, years in IS Agencies/organizations, and highest IS education level attained. The second part asked respondents to describe their jobs as objectively as they could in terms of one of the three major IS worker job

categories, namely project manager, systems analyst/designer, and programmer. If the respondents were non-IS workers they were asked to indicate so. In addition, respondents were asked to describe the educational background suited to their job requirements. The third part gave respondents a list of 20 specific knowledge, skills, and abilities categories (derived from the recommendations made by the ACM curriculum model) and asked them to rate the importance of these categories to their job.

The questionnaire consisted of a series of 42 items (individual questions) designed to combine with the answers to other measurement questions in such a way that they would make up the answer(s) to each of the investigative questions. For convenience, the investigative questions are repeated:

1. What is the background of the typical incumbent of an officer position in a RAAF Information Systems Agency/organization?

2. Which of the three major information systems job categories, namely project manager, systems analyst/designer, and programmer, most accurately describes the incumbents' of officer positions in Information Systems Agencies/organizations jobs?

3. What educational background(s) is/are suited to incumbents' of officer positions in Information System Agencies/organizations job requirements?

4. Which of the 20 specific KSA categories are important to incumbents' of officer positions in Information Systems Agencies/organizations jobs?

To recapitulate, each investigative question was addressed by a number of measurement questions. For example, to answer investigative question 1, ten of the items involved asking the respondents measurement questions such as "My age group is:", and "My highest information systems educational level attained was:".

Pretesting. To detect weaknesses in the questionnaire (Emory and Cooper, 1991:376), it was pretested on two RAAF officers stationed at Wright-Patterson Air Force Base, Ohio. These officers are former incumbents of officer positions in ISAs. Comments and evaluations of the questionnaire were noted and used to ensure that it was easy to fill out, could be completed quickly, and was relevant to the investigative questions.

Data Collection Plan

Evidence of Data Reliability. "A measure is reliable to the degree that it supplies consistent results" (Emory and Cooper, 1991:185). By test-retesting the survey on 12 information resource management graduate students at the United States Air Force Institute of Technology over an interval of two weeks, the questionnaire's stability (a perspective on reliability) was tested. A GIR93-D Conversion Table was used to translate RAAF terms into

United States Air Force terms. The table is displayed in Appendix B. To determine the correlation between each of the parts/sections of the test-retest surveys, the authors broke down the survey accordingly. Then, four correlations were performed. The coefficient of correlation "r" between the:

1. background information was .78,
2. job categories was .70,
3. educational background was .78, and
4. KSAs was .79.

Thus, each part/section of the test-retest surveys has a fair reliability (Steel, 1993). The "r" of .78 for background information, suggests that it may have been prudent for the authors to have pretested the GIR93-D Conversion Table. On the other hand, some of the demographic questions which showed variance, such as "My highest information systems educational level attained was:", were not on the table because the terms were the same.

Scoring, Grouping, and Collecting Data. In phrasing the questions, the authors used 37 multiple-choice, and five comment measurement questions. Multiple-choice questions were used when the authors could offer the respondents a list of preestablished answers that would tell the authors what they wanted to know (Albrecht and Bradford, 154:1990). For example, "My gender is: 1) male, 2) female.". The most common scales for the multiple-choice questions in the

questionnaire were the five-point (20 items) and seven-point (5 items) "Likert scale" types. That is, the respondent had five or seven options from which to choose, ranging respectively from "Not Useful to Essential" and "Very Inaccurate" to "Very Accurate". The comment questions (referred to as "open-ended" in the questionnaire) "allow[ed] the person responding to express the answer in his or her own words" (Albrecht and Bradford, 1991:154).

The measurement questions were grouped into a logical sequence, so they flowed from one topic to another. For example, the second part of the questionnaire asked respondents to describe their jobs as objectively as they could in terms of one of the three major IS job categories. In addition, it asked respondents to describe the educational background suited to their job requirements.

Answers to the measurement questions were collected on AFIT Form 11E. After analysis, generalizations to the investigative questions were made from the data collected by the measurement questions.

Data Analysis

All of the data collected was processed, described, and reported through the use of data analysis software. The software system used for this study was the SAS System Release 6.07 running on Digital Equipment Corporation VAX Model 6000-420 under VMS. The four procedures used for data analysis were one-way frequency tables, means, one-way

analyses of variance (ANOVA), and a t-test. The questionnaire data, and the questionnaire data analysis SAS procedures are displayed at Appendixes C and D respectively. In addition, an analysis of the data is presented in Chapter IV.

IV. Findings and Analysis

Introduction

This chapter discusses and displays the findings of our research with respect to each of the investigative questions based on data from each of the parts of the questionnaire.

Thirty-five (about 54 percent) of the incumbents of officer positions in Information Systems Agencies, and the Directorate of Communications and Information Systems - Air Force, took the time to complete and return the questionnaire. Regrettably, however, two of the 35 response sheets were returned incomplete, and were consequently discarded. In addition, five of the respondents omitted answers to Part II, Section One, question 11. Question 11 asked respondents to describe their jobs, as objectively as they could. Nevertheless, by comparing the remiss respondents' answers to the other 28 respondents' answers to the two "open-ended" questions in Part II, Section One, the authors were able to class the remiss respondents into job categories.

Data from each of the parts of the questionnaire are reported in this section through the use of tables.

Background Information

The purpose of Part I of the questionnaire was to obtain a picture of the background of the "typical" incumbent of an officer position in an ISA/DCIS-AF. The

frequency tables for questions 1 to 10 are presented in Table 1.

TABLE 1

PERSONAL CHARACTERISTICS OF RESPONDENTS

Characteristic	Frequency	Percentage
Age Group		
Less than 20	0	.0
20 to 25	8	24.2
26 to 30	5	15.2
31 to 40	17	51.2
41 to 50	2	6.1
51 to 60	1	3.0
More than 60	0	.0
	33	100.0
Rank		
Pilot Officer or equivalent	2	6.1
Flying Officer or equivalent	4	12.1
Flight Lieutenant or equivalent	11	33.3
Squadron Leader or equivalent	11	33.3
Wing Commander or equivalent	4	12.1
Group Captain or equivalent	1	3.0
Other	0	.0
	33	100.0
Gender		
Male	27	81.8
Female	6	18.2
	33	100.0

Table 1 (Cont)

Characteristic	Frequency	Percentage
Education Level		
Non high school graduate	0	.0
High school graduate	1	3.0
Bachelor's degree	15	45.5
Graduate Diploma	11	33.3
Master's degree	6	18.2
Doctoral degree	0	.0
	33	100.0
Years in Present Job		
Less than 1 year	15	45.5
1 year but less than 2	11	33.3
2 years but less than 3	5	15.2
3 years but less than 4	2	6.1
4 years or more	0	.0
	33	100.0
Years in Service		
Less than 3 years	1	3.0
3 years, but less than 6 years	3	12.1
6 years, but less than 9 years	6	18.2
9 years, but less than 12 years	5	15.2
12 years, but less than 15 years	2	6.1
15 years or more	16	51.5
	33	100.0

Table 1 (Cont)

Characteristic	Frequency	Percentage
Information Systems Agency/ organization		
Directorate of Communications and Information Systems - Air Force	6	18.2
Directorate of Materiel Management Information Systems	2	6.1
Staff Officer Information Systems - Air Force Office	4	12.1
Staff Officer Personnel and Manpower Information Management	4	6.1
Directorate of Logistics Information Services	12	36.4
Staff Officer Information Systems	4	12.1
Staff Officer Information Systems - Training Command	1	3.0
	33	100.0
Years in Information Systems Agencies/organizations		
Less than 2 years	19	57.6
2 years but less than 4	9	27.4
4 years but less than 6	3	9.1
6 years but less than 8	1	3.0
8 years or more	1	3.0
	33	100.0
Branch		
General List	1	3.0
General Duties	7	24.2
Engineer	10	30.3
Supply	11	33.3
Special Duties	3	9.1
Other	1	3.0
	33	100.0

Table 1 (Cont)

Characteristic	Frequency	Percentage
Highest Information Systems Education Level Attained		
Bachelor's degree	8	24.2
Graduate Diploma	7	21.2
Master's degree	1	3.0
Doctoral degree	0	0.0
None of the above	17	51.5
	33	100.0

66.6 percent of the respondents were flight lieutenants or equivalent and squadron leaders or equivalent, and 51.5 percent were in their thirties. Overall, over half the respondents reported an education level beyond a bachelor's degree; 48.4 percent reported an IS education level; over one third were assigned to the Directorate of Logistics Information Services (DLIS); 45.5 percent had been in their current positions for less than one year; and over half had been in an Information Systems Agency/organization for less than two years.

Job Characteristics

Part II, Section One, of the questionnaire asked the respondents to describe their jobs as objectively as they could. If the respondents were IS workers, they were asked to indicate which of the three major IS job categories, namely project manager, systems analyst/designer, or

programmer, most accurately describes their job. On the other hand, if the respondents were non-IS workers, they were asked to indicate so. The frequency distribution of question 11 is presented in Table 2.

TABLE 2

JOB CATEGORIES

Category	Frequency	Percentage
Project manager	17	51.5
Systems analyst/designer	3	9.1
Programmer	0	.0
Non-IS	13	39.4
	33	100.0

In addition, if the respondents were IS workers, they were given an "open-ended" opportunity to suggest an additional major IS job category that more accurately describes their job, and to define it. There were 11 responses to this question. 55 percent of IS worker respondents answered this question. The responses were grouped in like categories with corresponding frequencies. The results of the compiled answers are presented in Table 3.

TABLE 3

ADDITIONAL MAJOR IS JOB CATEGORIES SUGGESTED BY OPEN-ENDED QUESTION

Category - [Definition]	Frequency	Percentage
Systems manager - [One who maintains and operates a working system]	5	45.5
IS/MIS manager - [One who manages total IS resources]	3	27.3
Strategic planner - [One who develops strategic IS plans]	2	18.2
Other	1	9.0
	11	100.0

The additional major IS job categories respondents suggested and defined appear to be organizational job titles/descriptions rather than major IS job categories. Nevertheless, they seem to be satisfactory subsets of the project manager IS job category. Therefore, the mean ratings of the usefulness in their present jobs, of each of the knowledge, skills, and abilities derived from the recommendations made by the Association for Computing Machinery's model curriculum should not differ among the project managers.

If the respondents were non-IS workers, they were given an "open-ended" opportunity to suggest a major non-IS job category that describes their job, and to define it. The were eight responses to this question. 61.5 percent of non-IS worker respondents answered this question. The responses

were grouped in like categories with corresponding frequencies. Groups that had two or more entries were noted. The results of the compiled answers are presented in Table 4.

TABLE 4

ADDITIONAL MAJOR NON-IS JOB CATEGORIES SUGGESTED BY OPEN-ENDED QUESTION

Category - [Definition]	Frequency	Percentage
Acquisition manager - [One who procures IS related goods and services]	4	50.0
Policy-maker - [One who is involved in IS policy development]	2	25.0
Manager/Planner - [One who plans IS projects or manages existing projects]	2	25.0
	8	100.0

Similar to the additional major IS job categories, the additional major non-IS job categories respondents suggested and defined appear to be generic organizational job titles/descriptions rather than major non-IS job categories. Nevertheless, they serve to demonstrate the diversity of the duties incumbents of officer positions in the ISAs/DCIS-AF perform. In addition, they suggest that both the mean ratings of the educational background suited to the respondents' job requirements, and the mean ratings of the usefulness, in their present jobs, of each of the KSA categories, may differ between non-IS and IS workers.

Part II, Section Two, of the questionnaire asked respondents to describe the educational background suited to their job requirements. Specifically, it asked the respondents to indicate how accurate six statements were in describing the educational background suited to their job requirements. The respondents were required to answer on a scale numbered 1 to 7, where 1 was "Very Inaccurate", 2 was "Mostly Inaccurate", 3 was "Slightly Inaccurate", 4 was "Uncertain", 5 was "Slightly Accurate", 6 was "Mostly Accurate", and 7 was "Very Accurate". The univariate descriptive statistics for questions 12 to 17 are presented in Table 5. In addition, the frequency tables for questions 12 to 17 are displayed in Appendix F.

TABLE 5

EDUCATIONAL BACKGROUND SUITED TO RESPONDENTS' JOB REQUIREMENTS

Educational Background	Mean	Standard Deviation
Bachelor's Degree	4.24	2.00
Bachelor's Degree in Information Systems	4.48	1.75
Graduate Diploma	3.09	1.65
Graduate Diploma in Information Systems	4.21	1.85
Master's Degree	1.67	1.22
Master's Degree in Information Systems	2.42	1.80

The responses presented in Table 5 suggest that, overall, the respondents were uncertain about the educational background suited to their job requirements. Only one respondent was certain that either a non-IS master's degree or a master's degree in IS was suited to his/her job requirements. Also, most respondents were uncertain whether a graduate diploma in IS, a non-IS bachelor's degree, or a bachelor's degree in IS was suited to their job requirements. The educational background(s) suited to respondents' job requirements from Part II, Section Two, were then rank ordered by mean. The educational background receiving the highest mean was ranked first, followed by the others in descending order.

TABLE 6

EDUCATIONAL BACKGROUND SUITED TO RESPONDENTS' JOB REQUIREMENTS--RANK ORDERED BY MEAN

Educational Background	Mean	Standard Deviation
Bachelor's Degree in Information Systems	4.48	1.75
Bachelor's Degree	4.24	2.00
Graduate Diploma in Information Systems	4.21	1.85
Graduate Diploma	3.09	1.65
Master's Degree in Information Systems	2.42	1.80
Master's Degree	1.67	1.22

The respondents' apparent uncertainty about the educational background suited to their job requirements led us to hypothesize that the KSAs necessary to perform the respondents' jobs were being obtained through other than formal IS education; for example, through on-the-job training. To test this hypothesis, the authors evaluated the effect of the respondents' ranks (i.e., experience), and total years in IS Agencies/organizations (i.e., IS Agency/organization experience) on their mean ratings of the educational background suited to their job requirements. The results of these experiments are presented below.

Rank. To determine if the mean ratings of the educational background suited to the respondents' job requirements differed among the six ranks (pilot officer or equivalent, flying officer or equivalent, flight lieutenant or equivalent, squadron leader or equivalent, wing commander or equivalent, and group captain or equivalent), the authors tested:

Null Hypothesis. The null hypothesis was that mean (pilot officer or equivalent) = mean (flying officer or equivalent) = mean (flight lieutenant or equivalent) = mean (squadron leader or equivalent) = mean (wing commander or equivalent) = mean (group captain or equivalent).

Alternative Hypothesis. The alternative hypothesis was that the means were not all equal.

Six one-way analyses of variance were performed. Since the p-values for the tests were greater than the reference

probability value of .05, the null hypothesis was not rejected. There was insufficient evidence to indicate that the means for at least two of the ranks differed at alpha = .05.

Years in IS Agencies/Organizations. To determine if the mean ratings of the educational background suited to the respondents' job requirements differed among the five years-in-IS Agencies/organizations intervals (less than 2 years, 2 years but less than 4, 4 years but less than 6, 6 years but less than 8, and 8 years or more), the authors tested:

Null Hypothesis. The null hypothesis was that mean (less than 2 years) = mean (2 years but less than 4) = mean (4 years but less than 6) = mean (6 years but less than 8) = mean (8 years or more).

Alternative Hypothesis. The alternative hypothesis was that the means were not all equal.
Six one-way analyses of variance were performed. Since the p-values for the tests were greater than the reference probability value of .05, the null hypothesis was not rejected. There was insufficient evidence to indicate that the means for at least two of the years in IS Agencies/organizations intervals differed at alpha = .05.

Since no significant differences were found among the respondents' mean ratings of the educational background suited to their job requirements, the authors theorized that the respondents' ratings of the educational background suited to their job requirements may have been affected by

either the number of respondents who had not reported an IS education level (over half) or the number of respondents who were non-IS workers (about 40 percent). To test this theory, we evaluated the effect of the respondents' highest IS educational level attained and job categories on their mean ratings of the educational background suited to their job requirements. The results of these experiments are presented below.

Highest IS Educational Level Attained. To determine if the mean ratings of the educational background suited to the respondents' job requirements differed among the four highest IS educational level attained levels (bachelor's degree, graduate diploma, master's degree, and none), the authors tested:

Null Hypothesis. The null hypothesis was that mean (bachelor's degree) = mean (graduate diploma) = mean (master's degree) = mean (none).

Alternative Hypothesis. The alternative hypothesis was that the means were not all equal.

Six one-way analyses of variance were performed. Since the p-values for five of the tests were greater than the reference probability value of .05, the null hypothesis was not rejected in these experiments. There was insufficient evidence to indicate that the means for at least two of the highest IS educational level attained levels differed at alpha = .05. However, the p-value for one of the tests of .0053 was less than the reference probability value of .05;

therefore, the null hypothesis was rejected. There was sufficient evidence to indicate that the means ratings of the statement "A bachelor's degree in information systems is essential for my position" differed among the four highest IS educational level attained levels at alpha = .05. To know what the differences were, the authors "compute[d] the Bonferroni confidence intervals as well as the Scheffe confidence intervals ... and select[ed] the set exhibiting the greatest precision" (Neter and Wasserman, 1974:482). The Bonferroni test (p = .05) showed that the statement "A bachelor's degree in information systems is essential for my position" was significantly more accurate in describing the educational background suited to respondents' job requirements when the highest IS educational level attained was either a graduate diploma or a bachelor's degree, than when the respondents had not reported an IS education level. This led us to hypothesize that IS qualifications had been used by the Directorate of Personnel Officers - Air Force to match incumbents to IS worker positions.

To test this hypothesis, the authors evaluated the effect of the respondents' bachelor's degree/graduate diploma in IS and generic job category (i.e, qualifications match/do not match positions) on their mean ratings of the accuracy of the statement "A bachelor's degree in information systems is essential for my position.". The result of the experiment is presented below.

Bachelor's Degree/Graduate Diploma in IS and Generic Job Category. To determine if the mean ratings of the accuracy of the statement "A bachelor's degree in information systems is essential for my position" differed between the two bachelor's degree/graduate diploma and generic job categories combinations (bachelor's degree/ graduate diploma in IS and an IS worker, and bachelor's degree/graduate diploma in IS and a non-IS worker), the author's tested:

Null Hypothesis. The null hypothesis was that mean (bachelor's degree/graduate diploma in IS and an IS worker) = mean (bachelor's degree/graduate diploma in IS and a non-IS worker).

Alternative Hypothesis. The alternative hypothesis is that the two means are not equal.
A t-test was performed. Since the p-value for the test was greater than the reference probability value of .05, the null hypothesis was not rejected. There was insufficient evidence to indicate that the means for the bachelor's degree/graduate diploma in IS and IS worker, and bachelor's degree/graduate diploma in IS and non-IS worker combinations differed at alpha = .05.

Since no significant difference was found, the authors theorize that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education.

Job Categories. To determine if the mean ratings of the educational background suited to the respondents' job requirements differed among the three job categories (project manager, systems analyst/designer, and non-IS), the authors tested:

Null Hypothesis. The null hypothesis was that mean (project manager) = mean (systems analyst/designer) = mean (non-IS).

Alternative Hypothesis. The alternative hypothesis was that the means were not all equal.
Six one-way analyses of variance were performed. Since the p-values for the tests were greater than the reference probability value of .05, the null hypothesis was not rejected. There was insufficient evidence to indicate that the means for at least two of the job categories differed at alpha = .05.

Because only one difference was found among the respondents' mean ratings of the educational background suited to their job requirements, we are so far uncertain about where respondents obtain the KSAs necessary to perform their jobs.

The "open-ended" question which asked respondents to discuss the need for tertiary IS education for their position shed some light on where the respondents' thought the KSAs necessary to perform their jobs are being obtained. Their were 12 responses to this question. 36.4 percent of respondents answered this question. The responses were

grouped in like categories with corresponding frequencies. The results of the compiled answers are presented in Table 7.

TABLE 7

SUMMARY OF NEED FOR TERTIARY IS EDUCATION IN RESPONDENTS' POSITIONS OPEN-ENDED QUESTION

Category	Frequency	Percentage
IS education is generally required or would be advantageous.	5	41.7
IS education is definitely needed.	3	25.0
Education from a discipline other than IS is preferred.	3	25.0
Practical experience is needed instead of IS education.	1	8.3
	12	100.0

Knowledge, Skills, and Abilities

Part III of the questionnaire gave respondents a list of 20 KSA categories (derived from the ACM model curriculum) and asked them to rate the importance of these categories to their job. The respondents were required to answer on a scale numbered 1 to 5 where 1 was "Not Useful", 2 was "Somewhat Useful", 3 was "Useful", 4 was "Very Useful", and 5 was "Essential". The univariate descriptive statistics for questions 18 to 37 are presented in Table 8. In addition, the frequency tables for questions 18 to 37 are displayed in Appendix G.

TABLE 8

IMPORTANCE OF KNOWLEDGE, SKILLS, AND ABILITIES TO RESPONDENTS' JOBS

Knowledge, Skills, and Abilities	Mean	Standard Deviation
Information Gathering Techniques	3.73	1.13
System Design Topics	3.30	1.07
File Design	2.06	1.20
Planning and Control of System Projects	3.76	1.32
Human Relations in Systems Development	3.33	.96
Human Factors in Equipment Design and Work Layout	2.55	1.09
Introductory Computer and Information Systems Concepts	4.39	.97
Application Programming Languages	2.18	.95
Job Control Language	1.61	.69
Database Management Systems	3.36	1.03
Operating Systems	3.39	1.03
Mainframe Hardware	2.67	1.08
Micro/Minicomputer Hardware	3.64	1.02
Telecommunications Concepts	3.52	1.06
Computer Security Controls and Auditing	3.61	.90
Software Package Analysis	3.06	1.06
Computer Operations	3.58	.97
Legal Aspects of Computing	2.76	1.12
Computer Simulation	1.97	1.02

Table 8 (Cont)

Knowledge, Skills, and Abilities	Mean	Standard Deviation
Statistical Decision Theory	1.82	.88

To indicate the degree of usefulness of each of the KSAs in Table 8 to the respondents' three job categories, the authors broke down the responses accordingly. This breakdown is presented in Table 9.

TABLE 9

IMPORTANCE OF KNOWLEDGE, SKILLS, AND ABILITIES TO THE THREE JOB CATEGORIES

Knowledge, Skills, and Abilities	Project Manager (Mean (Standard Deviation))	Systems Analyst/ Designer	Non-IS
Information Gathering Techniques	3.82 (1.19)	4.00 (1.00)	3.69 (1.44)
System Design Topics	3.65 (1.00)	3.33 (.58)	2.85 (1.14)
File Design	2.18 (1.24)	3.33 (.58)	1.62 (1.04)
Planning and Control of System Projects	4.24 (1.09)	3.67 (1.53)	3.15 (1.41)
Human Relations in Systems Development	3.71 (.69)	3.67 (.58)	2.77 (1.09)

Table 9 (Cont)

Knowledge, Skills, and Abilities	Project Manager (Mean (Standard Deviation))	Systems Analyst/ Designer	Non-IS
Human Factors in Equipment Design and Work Layout	2.76 (1.09)	2.67 (1.15)	2.23 (1.09)
Introductory Computer and Information Systems Concepts	4.76 (.75)	4.33 (1.15)	3.92 (1.04)
Application Programming Languages	2.35 (.86)	2.33 (1.53)	1.92 (.95)
Job Control Language	1.76 (.43)	2.00 (1.00)	1.31 (.75)
Database Management Systems	3.52 (1.07)	4.00 (1.00)	3.00 (.91)
Operating Systems	3.29 (.77)	4.00 (1.73)	3.38 (1.19)
Mainframe Hardware	2.71 (1.10)	2.67 (1.15)	2.62 (1.12)
Micro/Minicomputer Hardware	3.88 (.93)	3.33 (1.53)	3.38 (1.04)
Telecommunications Concepts	3.41 (1.00)	3.00 (1.00)	3.76 (1.17)
Computer Security Controls and Auditing	3.82 (.73)	3.00 (1.00)	3.46 (1.05)
Software Package Analysis	2.76 (.90)	3.33 (.58)	3.38 (1.26)
Computer Operations	3.76 (.66)	4.00 (1.00)	3.23 (1.24)

Table 9 (Cont)

Knowledge, Skills, and Abilities	Project Manager (Mean (Standard Deviation))	Systems Analyst/ Designer	Non-IS
Legal Aspects of Computing	3.00 (1.12)	3.00 (.0)	2.38 (1.19)
Computer Simulation	2.18 (1.07)	3.00 (1.00)	1.46 (.66)
Statistical Decision Theory	1.94 (1.03)	2.33 (.58)	1.54 (.66)

To determine if the mean ratings of the usefulness, in their present jobs, of each of the KSA categories, differed among the three job categories, the authors tested:

Null Hypothesis. The null hypothesis was that mean (project manager) = mean (systems analyst/designer) = mean (non-IS).

Alternative Hypothesis. The alternative hypothesis was that the means were not all equal.

A one-way analysis of variance was performed. Since the p-value for the test was greater than the reference probability value of .05, the null hypothesis was not rejected. There was insufficient evidence to indicate that the means for at least two of the job categories differed at alpha = .05.

The importance of the KSAs to the respondents' jobs, were then rank ordered by mean. The KSA receiving the highest mean was ranked first, followed by the others in descending order.

TABLE 10

IMPORTANCE OF KNOWLEDGE, SKILLS, AND ABILITIES TO RESPONDENTS' JOBS--RANK ORDERED BY MEAN

Knowledge, Skills, and Abilities	Mean	Standard Deviation
Very Useful		
Introductory Computer and Information Systems Concepts	4.39	.97
Useful		
Information Gathering Techniques	3.79	1.24
Planning and Control of System Projects	3.76	1.32
Micro/Minicomputer Hardware	3.64	1.02
Computer Security Controls and Auditing	3.61	.90
Computer Operations	3.58	.97
Telecommunications Concepts	3.52	1.06
Operating Systems	3.39	1.03
Database Management Systems	3.36	1.03
Human Relations in Systems Development	3.33	.96
System Design Topics	3.30	1.07
Software Package Analysis	3.06	1.06

Table 10 (Cont)

Knowledge, Skills, and Abilities	Mean	Standard Deviation
Somewhat Useful		
Legal Aspects of Computing	2.76	1.12
Mainframe Hardware	2.67	1.08
Human Factors in Equipment Design and Work Layout	2.55	1.09
Application Programming Languages	2.18	.95
File Design	2.06	1.20
Not Useful		
Computer Simulation	1.97	1.02
Statistical Decision Theory	1.82	.88
Job Control Language	1.61	.69

Overall, the responses indicated 12 of the KSAs are at least useful to respondents in their present jobs. Very few found "Introductory Computer and Information Systems Concepts" less than very useful. Also, most respondents found KSAs such as "Information Gathering Techniques" and "Planning and Control of System Projects" to be useful. In fact, 85 percent of the KSAs averaged above 2 (i.e., "Useful"). In light of the respondents' apparent uncertainty about the educational background suited to their job requirements, the fact that the respondents find most of

the KSAs derived from the ACM's model curriculum useful strengthens the authors' theory that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education.

An "open-ended" question asked respondents to suggest additional KSAs, useful in their present jobs, and to rate them on the 1 to 5 scale. Their were 13 responses to this question. 39.4 percent of respondents answered this question. Because some of the additional KSAs were not rated, the responses were grouped in like categories with corresponding frequencies. Groups that had three or more entries were noted. The results of the compiled answers are presented in Table 11.

The additional KSAs respondents suggested appear to be either organizational KSAs such as "Managerial Skills" or technological KSAs such as "Networking Knowledge", the latter being a subset of the "Telecommunications Concepts" KSA derived from the ACM model curriculum. Regardless, in light of the fact that the ACM model curriculum consists of five technical courses and five organizational courses, and has an additional six course slots that are available to cater to individual degree or program requirements (Nunamaker, Couger, and Davis, 1982:786), it could quite easily accommodate the vast majority of the additional KSAs.

TABLE 11

SUMMARY OF ADDITIONAL KNOWLEDGE, SKILLS, AND ABILITIES, USEFUL IN RESPONDENTS' PRESENT JOBS

Knowledge, Skills, and Abilities	Frequency	Percentage
Managerial Skills	12	29.4
Acquisition and Outsourcing Skills	5	12.2
User Interface Skills	5	12.2
Networking Knowledge	4	9.7
Strategic Planning	3	7.3
Project Management	3	7.3
IS Quantitative Techniques	3	7.3
Information Management	3	7.3
	41	100.0

In addition, an "open-ended" question asked respondents to discuss the need for tertiary IS education in the Royal Australian Air Force. There were 15 responses to this question. 45.5 percent of respondents answered this question. They responses were grouped in like categories with corresponding frequencies. The results of the compiled answers are presented in Table 12.

TABLE 12

SUMMARY OF NEED FOR TERTIARY IS EDUCATION IN THE RAAF
OPEN-ENDED QUESTION

Category	Frequency	Percentage
IS education is needed in support of:		
Strategic planning	1	6.7
Business planning	3	20.0
Outsourcing	1	6.7
Project management	2	13.3
IS education is needed for:		
Career development	2	13.3
Maintaining a global perspective	4	26.7
An alternative to IS education is:		
Systems management training	2	13.3
	15	100.0

86.7 percent of respondents saw a need for tertiary IS education in the RAAF. On the other hand, 13.3 percent saw a need for training instead of IS education. So, there is still no definitive answer as to where the KSAs necessary to perform the respondents' jobs are being obtained.

Summary

Background Information. 66.6 percent of the respondents were flight lieutenants or equivalent and squadron leaders or equivalent, and 51.5 percent were in their thirties. Overall, half the respondents reported an

education level beyond a bachelor's degree; 48.5 percent reported an IS education level; over one third were assigned to DLIS; 45.5 percent had been in their current positions for less than one year; and over half had been in an IS Agency/organization for less than two years.

Job Characteristics. Over 60 percent of the respondents were assigned to IS job categories. The open-ended opportunities for respondents to suggest and define additional IS, and non-IS work job categories, produced what appear to be organizational job titles/descriptions rather than major IS/non-IS job categories.

Overall, the responses suggested that respondents were uncertain about which educational background best suited their job requirements. Only one respondent was certain that either a non-IS master's degree or a master's degree in IS was suited to his/her job requirements. Also, most respondents were uncertain whether a graduate diploma in IS, a non-IS bachelor's degree, or a bachelor's degree in IS was suited to their job requirements.

The respondents' apparent uncertainty about the educational background suited to their job requirements led us to hypothesize that the KSAs necessary for the respondents' jobs were being obtained through other than formal IS education; for example, through on-the-job training. To test this hypothesis, the authors evaluated the effect of the respondents' ranks (i.e., experience), and total years in IS Agencies/organizations (i.e., IS

Agency/organization experience) on their mean ratings of the educational background suited to their job requirements.

Since no differences were found among the respondents' mean ratings of the educational background suited to their job requirements, the authors theorized that the respondents' ratings of the educational background suited to their job requirements may have been affected by either the number of respondents who had not reported an IS education level (over half) or the number of respondents who were non-IS workers (about 40 percent). To test this hypothesis, the authors evaluated the effect of the respondents' highest IS educational level attained and job categories on their mean ratings of the educational background suited to their job requirements. Only one difference was found among the respondents' mean ratings of the educational background suited to their job requirements.

The statement "A bachelor's degree in information systems is essential for my position" was significantly more accurate in describing the educational background suited to respondents' job requirements when the highest IS educational level attained was either a graduate diploma or a bachelor's degree, than when the respondents had not reported an IS education level. This led us to hypothesize that IS qualifications had been used to match incumbents to IS worker positions.

However, since no significant difference was found between bachelor's degree/graduate diploma in IS and IS

worker, and bachelor's degree/graduate diploma in IS and non-IS worker respondents, the authors theorize that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education.

The "open-ended" question which asked respondents to discuss the need for tertiary IS education for their position shed some light on where the respondents' thought the KSAs necessary to perform their jobs are being obtained; 33.3 percent of respondents seeing a need for either non-IS tertiary education, or training instead of IS education.

Knowledge, Skills, and Abilities. Overall, the responses indicated 12 of the KSAs are at least useful to respondents in their present jobs. Only seven respondents found "Introductory Computer and Information Systems Concepts" less than very useful. Also, most respondents found KSAs such as "Information Gathering Techniques" and "Planning and Control of System Projects" to be useful. In fact, 85 percent of the KSAs averaged above 2 (i.e., "Useful"). In light of the respondents' apparent uncertainty about the educational background suited to their job requirements, the fact that the respondents find most of the KSAs derived from the ACM's model curriculum useful strengthens the authors' theory that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education.

The additional KSAs respondents suggested appear to be either organizational KSAs such as "Managerial Skills" or technological KSAs such as "Networking Knowledge", the latter being a subset of the "Telecommunications Concepts" KSA derived from the ACM model curriculum. Regardless, in light of the fact that the ACM model curriculum consists of five technical courses and five organizational courses, and has an additional six course slots that are available to cater to individual degree or program requirements (Nunamaker, Couger, and Davis, 1982:786), it could quite easily accommodate the vast majority of the additional KSAs.

Finally, the open-ended opportunity for respondents to discuss the need for tertiary IS education in the RAAF, produced two suggestions (13.3 percent) that Systems Manager training was an alternative to IS education. So, there is still no definitive answer as to where the KSAs necessary to perform the respondents' jobs are being obtained.

V. Conclusions, Recommendations, and Future Research

On the 15 July 1993, Air Marshall Gration released Picsgram 3/93 outlining the future management of the RAAF Officer Corps with a view "to maintain[ing] an Officer Corps with appropriate leadership, management and professional skills to meet the RAAF's mission" (Gration, 1993:1). One of the implementations outlined is a sub-specialization in information systems. The selection of IS as a sub-specialization is indicative of the future role that IS will play in the RAAF. However, the 1990/94 Air Force Information Systems Master Plan states that there is a shortage of IS educated personnel employed in RAAF IS but does not contain any implementation plans to deal with this problem. If IS in the RAAF is to be an effective and efficient function, benefiting from current and future information technology, an IS educational strategy needs to be formulated. This thesis endeavors to provide useful recommendations on the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate professional education at the Master's level. The recommendations provided may influence the planning of IS education strategies, and offer direction for further research.

In the literature review, the ACM model curriculum was identified and validated as an archetype for graduate programs in IS. The aim of the ACM model curriculum is to

produce graduates with specific knowledge, skills, and abilities through the courses offered.

In research conducted in 1987 and 1988, Cheney and others point out that the KSAs derived from the ACM model curriculum are perceived by the practitioners as those needed by IS workers.

With this validated list of KSAs appropriate for IS workers the authors could assess the appropriateness, to the RAAF, of the ACM's model curriculum, at the Master's level, based on the importance of the KSA categories derived from the ACM model curriculum to the incumbents of officer positions in the Information Systems Agencies/Directorate of Communications and Information Systems - Air Force. Administering the survey to a nonprobability sample of 65 incumbents of officer positions in the ISAs and DCIS-AF provided a snapshot of the current needs and perceptions of IS education within this group of RAAF IS/non-IS workers. 33 usable responses were received and analyzed. As no occupational analysis of RAAF IS positions had been performed, the survey provided the sole source of answers to the following investigative questions:

1. What is the background of the typical incumbent of an officer position in a RAAF IS Agency/organization?

2. Which of the three major IS job categories, namely project manager, systems analyst/designer, and programmer most accurately describes the incumbents of officer positions in IS Agencies/organizations jobs?

3. What educational background(s) is/are suited to incumbents of officer positions in IS Agencies/organizations job requirements?

4. Which of the 20 specific KSAs, are important to incumbents' of officer positions in IS Agencies/organizations jobs?

Conclusions of Investigative Questions

Background of Typical Incumbent. To develop a RAAF IS training plan that maximizes the RAAF's return for its training investment, it needs to obtain a picture of the background of the "typical" incumbent of an officer position in an ISA/DCIS-AF. The demographic data included rank, years in IS Agencies/organizations, and highest IS education level attained.

66.6 percent of the respondents were flight lieutenants or equivalent and squadron leaders or equivalent, and 51.5 percent had 15 or more years in the RAAF. On the other hand, 85 percent of the respondents had less than 4 years in IS Agencies/organizations, and over half had less than 2 years in IS Agencies/organizations. So, overall the respondent's experience is higher than their IS Agency/organization experience. In addition, by comparing the number of respondents with less than 2 years in their present jobs to the number of respondents with 2 years or more in IS Agencies/organizations, the author's believe that only about 21 percent of respondents are in at least

their second IS Agency/organization job. Therefore, undergraduate/graduate programs in IS need to meet the immediate needs of the people who attend them.

Overall, 97 percent of the respondents reported an education level beyond high school graduate; 53.1 percent beyond a bachelor's degree; and 18.2 percent at master's level. In addition, 48.4 percent of the respondents reported an IS education level; 50 percent beyond a bachelor's degree; and 6.3 percent at master's level. Furthermore, the responses suggested respondents were more certain about a graduate diploma in IS being suited to their job requirements than either a non-IS master's degree or a master's degree in IS. However, the overseas IS courses most utilized by the RAAF are traditionally at the Master's level.

The Australia Education Office (AEO) at the Australian Embassy in Washington, provides an insight into the differences at master's level between Australia and the United States (US). Australian master's degrees tend "to emphasize research more than coursework" (AEO, undated:1). This difference may exist because Australia offers a graduate diploma, whereas the US does not. So, a person with a bachelor's degree in the US who requires additional education would have to undertake a master's degree, whereas in Australia, the person could undertake either a graduate diploma or a master's degree depending on their focus. An example given by the AEO is a social science graduate who

changes career direction by doing a Graduate Diploma in Computer Science (AEO, undated:1).

IS Job Categories. The job category that most accurately describes the incumbents' of officer positions in the ISAs/DCIS-AF jobs is that of project manager. 51.5 percent of respondents were project managers, 9.1 percent systems analyst/designers, and 39.4 percent reported they were non-IS workers. The non-IS workers are employed in acquisition, policy making, and managing/planning. Despite the diversity of the duties incumbents of officer positions in the ISAs/DCIS-AF perform, there was no significant difference between the mean ratings of the usefulness, in their present jobs, of each of the KSA categories, among the three job categories.

Suitability of Educational Background. Overall, the responses suggested respondents were uncertain about the educational background suited to their job requirements. Only one respondent was certain that either a non-IS master's degree or a master's degree in IS was suited to his/her job requirements. Also, most respondents were uncertain whether a graduate diploma in IS, a non-IS bachelor's degree, or a bachelor's degree in IS was suited to their job requirements. However, overall, the responses suggested respondents were more certain about the latter educational backgrounds being suited to their job requirements.

The respondents' apparent uncertainty about the educational background suited to their job requirements led us to evaluate the effect of the respondents' ranks (i.e., experience), total years in IS Agencies/organizations (i.e., IS Agency/organization experience), highest IS educational level attained, and job categories on their mean ratings of the educational background suited to their job requirements. Only one difference was found among the respondents' mean ratings of the educational background suited to their job requirements.

The statement "A bachelor's degree in information systems is essential for my position" was significantly more accurate in describing the educational background suited to respondents' job requirements when the highest IS educational level attained was either a graduate diploma or a bachelor's degree, than when the respondents had not reported an IS education level.

Since no significant difference was found between bachelor's degree/graduate diploma in IS and IS worker, and bachelor's degree/graduate diploma in IS and non-IS worker respondents, the authors theorize that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education.

Two of the "open-ended" questions shed some light on where the respondents thought the KSAs necessary to perform their jobs are being obtained. 33.3 percent of respondents

(i.e., 12.1 percent of all respondents) to the "open-ended" question which asked them to discuss the need for tertiary IS education for their position saw a need for either non-IS tertiary education, or training instead of IS education. In addition, two (13.3 percent of) respondents to the "open-ended" question which asked them to discuss the need for tertiary IS education in the RAAF suggested that Systems Manager training was an alternative to IS education. So, there is still no definitive answer as to where the KSAs necessary to perform the respondents' jobs are being obtained.

Applicability of the KSAs. Overall, the responses indicated 17 of the KSAs are at least somewhat useful to the respondents in their present jobs. The fact that the respondents find most of the KSAs derived from the ACM's model curriculum at least somewhat useful supports the authors' theory that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education.

The respondents' apparent uncertainty about the educational background suited to their job requirements, together with the fact that they find most of the KSAs derived from the ACM's model curriculum at least somewhat useful warrants the question: Are the respondents obtaining the KSAs necessary to perform their jobs, and if so from where? Having ruled out experience and IS

Agency/organization experience, there is still no definitive answer. Nevertheless, formal IS education based on the ACM model curriculum is appropriate to the RAAF.

Benefits of this Research

Although the purpose of this research was to assess the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate professional education, the authors' believe that its findings are of value in helping DCIS-AF develop a RAAF IS training plan that maximizes the RAAF's return for its training investment.

First, our study provides a picture of the background of the "typical" incumbent of an officer position in an ISA/DCIS-AF. Overall, 48.4 percent reported an IS education level; and over half had been in an Information Systems Agency/organization for less than two years. So, undergraduate/graduate programs in IS need to meet the immediate needs of the people who attend them.

Secondly, this research suggests that respondents who had not reported an IS education level may not realize that the KSAs necessary to perform their jobs can be obtained through formal IS education. Our study indicated that 17 of the KSAs derived from the ACM model curriculum are at least somewhat useful to respondents in their present jobs. Therefore, the KSAs could be used to match the qualifications needed for people to fill positions with the positions.

Thirdly, the ACM model curriculum describes the structure of both bachelor's and master's level programs (Nunamaker, Couger, and Davis, 1982:781). So, in the absence of an occupational analysis, DCIS-AF could undertake a census of professional programs in IS in Australia, at both undergraduate and postgraduate level, highlighting programs which provide the KSAs necessary for people to perform their jobs.

Finally, the authors' methodology of selecting an accepted model curriculum for professional programs in IS; identifying the KSAs derived from the model curriculum recommendations; and asking the incumbents of officer positions in IS to indicate the degree of usefulness, in their present jobs, of each of the KSA categories; could be used, for example, to assess the appropriateness, to Base Information Systems Officers, of an undergraduate professional program in either IS or Computing Science. Similarly, our methodology could be used generically to evaluate non-IS programs.

With the fresh impetus of Picsgram 3/93 to "better match individuals with positions" (Gration, 1993:1), this research is timely in providing DCIS-AF with some of the wherewithal to accurately describe the qualifications needed for people to fill particular IS positions and to develop a RAAF IS training plan that maximizes the RAAF's return for its training investment by directing its training accordingly.

Recommendations

This research set out to assess the appropriateness, to the RAAF, of the ACM's model curriculum in IS with respect to graduate education at the Master's level. Our study indicated that 17 of the knowledge, skills, and abilities derived from the ACM model curriculum are at least somewhat useful to the incumbents of officer positions in the ISAs and DCIS-AF. Therefore, education based on the ACM model curriculum would be an appropriate mechanism to acquire the KSAs.

A graduate diploma in IS based on the ACM model curriculum is seen by the authors as the most appropriate IS education level for the incumbents of officer positions in the ISAs and DCIS-AF for the following reasons:

1. Nearly all respondents have bachelor's degrees (97% of respondents) and the graduate diploma is the next level.

2. Only one respondent was certain that a master's degree in IS was suited to his/her job requirements.

3. Graduate diplomas are shorter in length (only one academic year) and would be more cost effective than the longer master's degree.

While a US IS program, at the Master's level, can provide people with the KSAs needed to fill officer positions in the ISAs and DCIS-AF, the same KSAs could be provided by an Australian IS course, at the (uniquely Australian) graduate diploma level, at far less cost to the RAAF.

In light of the fact that our survey suggests that only about 21 percent of officers return to IS Agencies/organizations, in about 80 percent of cases, education must be costed against one posting. Any reduction in the cost of effective education will improve the efficiency of IS education.

Bachelor's degrees in IS should also be aligned to the KSAs, to ensure that the appropriate education is given to prospective incumbents of IS positions.

Strategic Planning of IS Education. The above recommendations do not stand alone. This research may also assist in the strategic planning of IS education. The respondents' uncertainty about what constitutes the best educational background to perform their current job mirrors the lack of knowledge of the KSAs provided by an IS education. IS educational plans need to promote the benefits of IS education: to encourage officers to pursue IS sub-specialization and to ensure that the RAAF has appropriate labor resources for their IS strategies. James (1992) outlines a checklist for strategic planning of IS education; and it has been applied to this research and IS education in the RAAF.

1. The KSAs have been identified for the officers incumbent in IS positions in the ISAs and DCIS-AF.

2. Programs based on the ACM model curriculum are a source of the KSAs. Other sources may have to be identified.

3. Identify the tertiary institutions that provide the appropriate programs.

4. Develop an implementation plan to establish IS education programs within the RAAF, ensuring that plan is maintained, updated, and replaced when necessary.

5. Ensure that the IS infrastructure supports the education plan that has been devised.

6. Define senior management's role in IS education, particularly in promoting IS education.

7. Investigate other directorates' education and training charters for possible synergy.

8. Compare actual levels of expenditure to the benefit being gained by the education.

9. Create a program for monitoring the effectiveness of the RAAF IS education program (as it relates to the RAAF's objectives).

10. Select a senior officer to be the IS education champion responsible for promoting IS education and its benefits (James, 1992:20-21).

Future Research

This research provides information on the education required by the incumbents of officer positions working in the ISAs and DCIS-AF. IS education is presented in the form of a model curriculum (being the ACM model curriculum) rather than a particular program. In lieu of an occupational analysis, the IS incumbents assessed a set of

KSAs that were derived from the ACM model curriculum and found 17 of them at least somewhat useful. However, no particular program has been identified as producing these KSAs. Future research should aim to highlight graduate diploma programs (using the ACM model curriculum's KSAs) that are particularly suitable for RAAF students to undertake. This could be achieved by undertaking a census of graduate diploma program in IS within Australia, matching the output KSAs of the program to the required KSAs of the RAAF IS incumbent. From the resulting information recommend programs that suitable for RAAF officers to undertake.

Appendix A: Survey Instrument

Department of Defence
(Air Force Office)

MINUTE PAPER

Loose

Survey Participant

SKILLS REQUIRED BY INCUMBENTS OF OFFICER POSITIONS IN INFORMATION SYSTEMS AGENCIES/ORGANISATIONS SURVEY

1. Enclosed is a survey questionnaire prepared by FLTLTs Ralph Kettle and Joe Taylor as part of their United States Air Force Institute of Technology research project. The survey aims to measure the skills required by incumbents of officer positions in Information Systems Agencies/Organisations. The results of the research project may influence the selection of the Information Systems courses that the RAAF sponsors a number of officers to undertake.

2. Please take the time to complete the questionnaire and return it within one week of receipt. Your individual responses will not be attributed to you personally.

3. The estimated time to complete the questionnaire is 15-20 minutes. Participation in the survey is voluntary but Ralph and Joe would certainly appreciate your help. If any further information or assistance is required, please contact CIS-Policy Coordination (CIS-PC), SQNLDR Henrik Ehlers on (06) 265-4005.

A.F. FOOKES
WGCDR
A/DCIS-AF
A-6-20
Ext 55512

Jul 93

GENERAL INFORMATION

The purpose of this questionnaire is to obtain background information about you, your job, and how you rate the importance of specific knowledge, skills, and abilities in your work. Specifically, this information is being collected in support of research assessing the appropriateness, to the RAAF, of a graduate professional program in information systems, at the Masters level, based on the Association for Computing Machinery's recommendations.

This questionnaire is divided into three parts. The first part requests background information on you. The second part asks you to describe your job as objectively as you can in terms of one of the three major IS worker job categories, namely: project manager, systems analyst/designer, and programmer. In addition, it asks you to describe the educational background suited to your job's requirements. The third part gives you a list of 20 specific knowledge, skills, and abilities categories and asks you to rate the importance of these categories to your job.

Thank you for your cooperation in participating in this study. If you have any questions, please contact the researchers at the following addresses:

Flight Lieutenant Ralph Kettle
200 Kimbary Drive
CENTERVILLE OH 45458
USA

(011-1-513) 885-5745

or

Flight Lieutenant Joe Taylor
927 Fawn Lea Trail
CENTERVILLE OH 45459
USA

(011-1-513) 436-1450

SKILLS REQUIRED BY INCUMBENTS OF OFFICER POSITIONS IN INFORMATION SYSTEMS AGENCIES/ORGANIZATIONS QUESTIONNAIRE

KEYWORDS

The following are definitions of keywords that recur throughout the questionnaire:

1. Information Systems: Information systems are those which are derived from the application of computer and communications technologies to the collection, storage, processing and dissemination of information.

2. Knowledge: The content or technical information needed to perform adequately in a job.

3. Skills: The specific psychomotor processes necessary to meet the current requirements of a specific job.

4. Abilities: The cognitive factors that represent present capabilities or achievement levels.

INSTRUCTIONS

This questionnaire contains 42 items (individual "questions"). The questionnaire booklet is broken into three parts. Part I contains the first 10 items in this booklet, Part II contains the next 10 items, and Part III contains the remaining 22 items. All numbered items must be answered by filling in the appropriate spaces on the machine-scored response sheet provided. If for any numbered item you do not find a response that fits your situation exactly, use the one which is the closest to the way you feel. All unnumbered items must be answered by writing in the appropriate spaces on the questionnaire.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. Make heavy black marks that fill in the space (of the response you select) on the response sheet.

2. Erase cleanly any response you wish to change.

3. Make no stray markings of any kind on the response sheet.

4. Do not staple, fold, or tear the response sheet.

You have been provided with one questionnaire booklet and one answer sheet. Do NOT fill in your name on either the booklet or the sheet so that your responses will be anonymous.

Each response block on the answer sheet has 7 spaces (numbered 1 through 7) or a 1-7 scale. The numbered questionnaire items normally require a response from 1-5, or 1-7 only, therefore, you will not need to fill in a space numbered 8, 9, or 10. Numbered questionnaire items are responded to by marking the appropriate space on the answer sheet as in the following example:

SCALE:

How accurate is the statement in describing your job?

1 = Very Inaccurate
2 = Mostly Inaccurate
3 = Sightly Inaccurate
4 = Uncertain
5 = Slightly Accurate
6 = Mostly Accurate
7 = Very Accurate

Sample item 1:

I prepare, debug, and test programs according to specifications prepared by systems designers.

(If sample item #1 is "mostly accurate" in describing your job, you would "blacken in" the corresponding number of that statement (mostly accurate = 6) on the sample answer sheet (below) for item numbered "sample response 1.")

Sample response: 001 1 2 3 4 5 6 7

O O O O O O O

PART I

BACKGROUND INFORMATION

This section of the survey contains several items dealing with personal characteristics. This information will be used to obtain a picture of the background of the "typical incumbent of an officer position in an Information Systems Agency/organization".

1. My age group is:

    1. Less than 20
    2. 20 to 25
    3. 26 to 30
    4. 31 to 40
    5. 41 to 50
    6. 51 to 60
    7. More than 60

2. My current rank is:

    1. Pilot Officer or equivalent
    2. Flying Officer or equivalent
    3. Flight Lieutenant or equivalent
    4. Squadron Leader or equivalent
    5. Wing Commander or equivalent
    6. Group Captain or equivalent
    7. Other

3. My gender is:

    1. Male
    2. Female

4. My highest educational level attained was:

    1. Non high school graduate
    2. High school graduate
    3. Bachelor's degree
    4. Graduate Diploma
    5. Master's degree
    6. Doctoral degree

5. My total years in my present job are:

1. Less than 1 year
2. 1 year but less than 2
3. 2 years but less than 3
4. 3 years but less than 4
5. 4 years or more

6. My total years in the Service are:

1. Less than 3 years
2. 3 years, but less than 6 years
3. 6 years, but less than 9 years
4. 9 years, but less than 12 years
5. 12 years, but less than 15 years
6. 15 years or more

7. My current Information Systems Agency/organization is:

1. Directorate of Communications and Information Systems - Air Force
2. Directorate of Material Management Information Systems
3. Staff Officer Information Systems - Air Force Office
4. Staff Officer Personnel and Manpower Information Management
5. Directorate of Logistics Information Services
6. Staff Officer Information Systems
7. Staff Officer Information Systems - Training Command

8. My total years in Information Systems Agencies/organizations are:

1. Less than 2 years
2. 2 years but less than 4
3. 4 years but less than 6
4. 6 years but less than 8
5. 8 years or more

9. My present branch is:

1. General List
2. General Duties
3. Engineer
4. Supply
5. Special Duties
6. Other

10. My highest information systems educational level attained was:

1. Bachelor's degree
2. Graduate Diploma
3. Master's degree
4. Doctoral degree
5. None of the above

PART II

JOB CHARACTERISTICS

This part of the questionnaire asks you to describe your job, as objectively as you can.

If you are an information systems worker, indicate on the answer sheet for item number "11" the number which is the most accurate description of your job. If, for example, your job requires you to be knowledgeable about programming techniques, you might choose the number three, so you would blacken in "3" on the answer sheet. On the other hand, if you are not an information systems worker, blacken in "4" on the answer sheet for item number "11", and skip to the unnumbered question on page 8.

11. Of the three major information systems worker job categories, I am a:

    1. Project manager - [Definition: One who coordinates the team's effort and determines how the team's resources should be allocated to produce a working system that complies with a given set of specifications on time and within budget].

    2. Systems analyst/designer - [Definition: One who defines the users' information needs and designs systems to generate the required information, including defining the content and structure of input forms, output reports, and files].

    3. Programmer - [Definition: One who is responsible for program creation (development and documentation)].

Unnumbered. This is an open-ended opportunity for you to suggest an additional major information systems worker job category that more accurately describes your job, and to define it.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Unnumbered. If you blackened in "4" on the answer sheet for item number "11", this is an open-ended opportunity for you

to suggest a major non-information systems worker job category that describes your job, and to define it.

_____
_____
_____
_____
_____
_____
_____
_____

Section Two

Listed below are a number of statements which could be used to describe the educational background suited to a job's requirements. You are to indicate whether each statement is an accurate or an inaccurate description of the educational background suited to your job's requirements. Please try to be objective as you can in deciding how accurately each statement describes the educational background suited to your job's requirements.

How accurate is the statement in describing the educational background suited to your job's requirements?

1 = Very Inaccurate
2 = Mostly Inaccurate
3 = Sightly Inaccurate
4 = Uncertain
5 = Slightly Accurate
6 = Mostly Accurate
7 = Very Accurate

12. A bachelor's degree is essential for my position.

13. A bachelor's degree in information systems is essential for my position.

14. A graduate diploma is essential for my position.

15. A graduate diploma in information systems is essential for my position.

16. A master's degree is essential for my position.

17. A master's degree in information systems is essential for my position.

Unnumbered. This is an open-ended opportunity for you to express your thoughts about the need for tertiary information systems education in your position.

PART III

KNOWLEDGE, SKILLS, AND ABILITIES

This part of the questionnaire gives you a list of 20 specific knowledge, skills, and abilities categories and asks you to rate the importance of these categories to your job. Use the following rating scale to indicate the degree of usefulness, in your present job, of each of the knowledge, skills, and abilities categories shown below.

1 = Not Useful
2 = Somewhat Useful
3 = Useful
4 = Very Useful
5 = Essential

18. Information Gathering Techniques

19. System Design Topics

20. File Design

21. Planning and Control of System Projects

22. Human Relations in Systems Development

23. Human Factors in Equipment Design and Work Layout

24. Introductory Computer and Information Systems Concepts

25. Application Programming Languages

26. Job Control Language

27. Database Management Systems

28. Operating Systems

29. Mainframe Hardware

30. Micro/Minicomputer Hardware

31. Telecommunications Concepts

32. Computer Security Controls and Auditing

33. Software Package Analysis

34. Computer Operations

PART III, continued

Use the following rating scale to indicate the degree of usefulness, in your present job, of each of the knowledge, skills, and abilities categories shown below.

1 = Not Useful
2 = Somewhat Useful
3 = Useful
4 = Very Useful
5 = Essential

35. Legal Aspects of Computing

36. Computer Simulation

37. Statistical Decision Theory

Unnumbered. This is an open-ended opportunity for you to suggest additional knowledge, skills, and abilities, useful in your present job, and to rate them on the 1 to 5 scale.

Unnumbered. This is an open-ended opportunity for you to express your thoughts about the need for tertiary information systems education in the RAAF.

Appendix B: GIR93-D Conversion Table

GIR93-D CONVERSION TABLE

Please use the following GIR93-D conversion table when completing the attached test questionnaire.

Location	Incumbents' of Officer Positions In Information Systems Agencies/ Organizations Term	GIR93-D Term
Throughout	your job	your last job
General information and Part II	RAAF	USAF
General information and Part II	your job's	your last job's
Title and Part I	Information Systems Agency/organization	information systems
Item number 2	1. Pilot Officer or equivalent	2d Lieutenant
	2. Flying Officer or equivalent	1st Lieutenant
	3. Flight Lieutenant or equivalent	Captain
	4. Squadron Leader or equivalent	Major
	5. Wing Commander or equivalent	Lieutenant Colonel
	6. Group Captain or equivalent	Colonel
	7. Other	Other
Parts I and II	Graduate Diploma	No GIR93-D term
Parts I and III	present job	last job
Item number 6	in the Service	active military service

GIR93-D Conversion Table (Cont)

Location	Incumbents' of Officer Positions In Information Systems Agencies/ Organizations Term	GIR93-D Term
Item number 7		No GIR93-D term. **Blacken in "4" on the answer sheet for item number "7".**
Item number 9	branch	AFSC or equivalent
Parts II and III	tertiary	undergraduate/ graduate
Part II	your position	your last position

Appendix C: Questionnaire Data

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00000574 44142663212663311344232542554344453 22
00000575 43152361551213311111133523545441441 1
00000576 44142661224563625543332331343345552 32
00000578 21131261214666611221311521221444443 11

Appendix D: Questionnaire Data Analysis SAS Program

```
options linesize = 80;

data thesis;
   infile thesis missover;
   input grpid 1-9 agegroup 9 crrntrnk 10 gender 11
      hgdclvtt 12 ttyrprjb 13 ttlyrssr 14 crnfsyag 15
      ttyrnfsy 16 prsntbrn 17 hgnfsydc 18 jbctgry 19
      bchlrsdg 20 bcdgnfsy 21 grdtdplm 22 grdpnfsy 23
      mstrsdgr 24 msdgnfsy 25 (knskbl1-knskbl20) (1.);

* assign the value '1' to a variable named NFSYDCJB when
* the incumbent of an officer position in an Information
* Systems Agency/DCIS-AF has attained either a bachelor's or
* graduate diploma in IS and is an IS worker.  if the
* incumbent has attained either a bachelor's or graduate
* diploma in IS and is a non-IS worker, NFSYDCJB is assigned
* the value '2';

   if hgnfsydc <= 2 and jbctgry <= 3
      then nfsydcjb = 1;
   else if hgnfsydc <=2 and jbctgry = 4
      then nfsydcjb = 2;

* create a multi-item scale using for the variables from the
* knowledge, skills, and abilities part of the
* questionnaire;

   knskbl = knskbl1 + knskbl2 + knskbl3 + knskbl4 + knskbl5
      + knskbl6 + knskbl7 + knskbl8 + knskbl9 + knskbl10
      + knskbl11 + knskbl12 + knskbl13 + knskbl14 + knskbl15
      + knskbl16 + knskbl17 + knskbl18 + knskbl19
      + knskbl20;

* obtain a picture of the background of the typical
* incumbent of an officer position in an Information Systems
* Agency/organization;

   proc freq;
      tables agegroup crrntrnk gender hgdclvtt ttyrprjb
         ttlyrssr crnfsyag ttyrnfsy prsntbrn hgnfsydc;

* describe the respondents' jobs;

   proc freq;
      tables jbctgry;

* describe the educational background suited to respondents'
* job requirements;

   proc freq;
```

```
   tables bchlrsdg bcdgnfsy grdtdplm grdpnfsy mstrsdgr
   msdgnfsy;


proc means;
   var bchlrsdg bcdgnfsy grdtdplm grdpnfsy mstrsdgr
      msdgnfsy;

* compare respondents' current ranks (pilot officer or
* equivalent, flying officer or equivalent, flight
* lieutenant or equivalent, squadron leader or equivalent,
* wing commander or equivalent, group captain or equivalent,
* and other) on their ratings of how accurately each
* statement described the educational background suited to
* their job requirements;

proc sort;
   by crrntrnk;

proc anova;
   class crrntrnk;
   model bchlrsdg = crrntrnk;
   means crrntrnk / bon scheffe;

proc anova;
   class crrntrnk;
   model bcdgnfsy = crrntrnk;
   means crrntrnk / bon scheffe;

proc anova;
   class crrntrnk;
   model grdtdplm = crrntrnk;
   means crrntrnk / bon scheffe;

proc anova;
   class crrntrnk;
   model grdpnfsy = crrntrnk;
   means crrntrnk / bon scheffe;

proc anova;
   class crrntrnk;
   model mstrsdgr = crrntrnk;
   means crrntrnk / bon scheffe;

proc anova;
   class crrntrnk;
   model msdgnfsy = crrntrnk;
   means crrntrnk / bon scheffe;

* compare respondents' total years in Information Systems
* Agencies/organizations (less than 2 years, 2 years but
* less than 4, 4 years but less than 6, 6 years but less
* than 8, and 8 years or more) on their ratings of how
```

```
* accurately each statement described the educational
* background suited to their job requirements;

   proc sort;
      by ttyrnfsy;

   proc anova;
      class ttyrnfsy;
      model bchlrsdg = ttyrnfsy;
      means ttyrnfsy / bon scheffe;

    proc anova;
      class ttyrnfsy;
      model bcdgnfsy = ttyrnfsy;
      means ttyrnfsy / bon scheffe;

   proc anova;
      class ttyrnfsy;
      model grdtdplm = ttyrnfsy;
      means ttyrnfsy / bon scheffe;

   proc anova;
      class ttyrnfsy;
      model grdpnfsy = ttyrnfsy;
      means ttyrnfsy / bon scheffe;

   proc anova;
      class ttyrnfsy;
      model mstrsdgr = ttyrnfsy;
      means ttyrnfsy / bon scheffe;

   proc anova;
      class ttyrnfsy;
      model msdgnfsy = ttyrnfsy;
      means ttyrnfsy / bon scheffe;

* compare respondents' highest information systems
* educational level attained (bachelor's degree, graduate
* diploma, master's degree, doctoral degree, and none of the
* above) on their ratings of how accurately each statement
* described the educational background suited to their job
* requirements;

   proc sort;
      by hgnfsydc;

   proc anova;
      class hgnfsydc;
      model bchlrsdg = hgnfsydc;
      means hgnfsydc / bon scheffe;

   proc anova;
      class hgnfsydc;
```

```
   model bcdgnfsy = hgnfsydc;
   means hgnfsydc / bon scheffe;

* compare respondents who have attained an IS educational
* level and are IS workers, and respondents who have
* attained an IS educational level and are non-IS workers
* on their ratings of how accurately the statement "A
* bachelor's degree in information systems is essential
* for my position." described the educational background
* suited to their job requirements;

  proc ttest;
      class nfsydcjb;
      var bcdgnfsy;

proc anova;
   class hgnfsydc;
   model grdtdplm = hgnfsydc;
   means hgnfsydc / bon scheffe;

proc anova;
   class hgnfsydc;
   model grdpnfsy = hgnfsydc;
   means hgnfsydc / bon scheffe;

proc anova;
   class hgnfsydc;
   model mstrsdgr = hgnfsydc;
   means hgnfsydc / bon scheffe;

proc anova;
   class hgnfsydc;
   model msdgnfsy = hgnfsydc;
   means hgnfsydc / bon scheffe;

* compare respondents' information systems worker job
* categories (project manager, systems analyst/designer, and
* programmer) on their ratings of how accurately each
* statement described the educational background suited to
* their job requirements;

proc sort;
   by jbctgry;

proc anova;
   class jbctgry;
   model bchlrsdg = jbctgry;
   means jbctgry / bon scheffe;

proc anova;
   class jbctgry;
   model bcdgnfsy = jbctgry;
   means jbctgry / bon scheffe;
```

```
   proc anova;
      class jbctgry;
      model grdtdplm = jbctgry;
      means jbctgry / bon scheffe;

   proc anova;
      class jbctgry;
      model grdpnfsy = jbctgry;
      means jbctgry / bon scheffe;

   proc anova;
      class jbctgry;
      model mstrsdgr = jbctgry;
      means jbctgry / bon scheffe;

   proc anova;
      class jbctgry;
      model msdgnfsy = jbctgry;
      means jbctgry / bon scheffe;

* the importance of the 20 knowledge, skills, and abilities
* categories to respondents' jobs;

   proc freq;
      tables knskbl1 knskbl2 knskbl3 knskbl4 knskbl5 knskbl6
         knskbl7 knskbl8 knskbl9 knskbl10 knskbl11 knskbl12
         knskbl13 knskbl14 knskbl15 knskbl16
         knskbl17 knskbl18 knskbl19 knskbl20;

   proc means;
      var knskbl1 knskbl2 knskbl3 knskbl4 knskbl5 knskbl6
         knskbl7 knskbl8 knskbl9 knskbl10 knskbl11 knskbl12
         knskbl13 knskbl14 knskbl15 knskbl16 knskbl17
         knskbl18 knskbl19 knskbl20;

* the importance of the 20 knowledge, skills, and abilities
* categories to the respondents' three major information
* systems worker job categories;

   proc means;
      var knskbl1 knskbl2 knskbl3 knskbl4 knskbl5 knskbl6
         knskbl7 knskbl8 knskbl9 knskbl10 knskbl11 knskbl12
         knskbl13 knskbl14 knskbl15 knskbl16 knskbl17
         knskbl18 knskbl19 knskbl20;
      by jbctgry;

* compare respondents' information systems worker job
* categories (project manager, systems analyst/designer, and
* programmer) on their ratings of the degree of usefulness,
* in their present jobs, of each of the knowledge, skills,
* and abilities categories;

   proc anova;
```

```
class jbctgry;
model knskbl = jbctgry;
means jbctgry / bon scheffe;
```

Appendix E: Analysis of Variance for Highest Information Systems Educational Level Attained Data

Analysis of Variance Procedure
Class Level Information

Class	Levels	Values
HGNFSYDC	4	1 2 3 5

Number of observations in data set = 33

Analysis of Variance Procedure

Dependent Variable: BCDGNFSY

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	34.41784441	11.47261480	5.21	0.0053
Error	29	63.82457983	2.20084758		
Corrected Total	32	98.24242424			

R-Square	C.V.	Root MSE	BCDGNFSY Mean
0.350336	33.07861	1.4835254	4.4848485

Source	DF	Anova SS	Mean Square	F Value	Pr > F
HGNFSYDC	3	34.41784441	11.47261480	5.21	0.0053

Analysis of Variance Procedure

Bonferroni (Dunn) T tests for variable: BCDGNFSY

NOTE: This test controls the type I experimentwise error rate but generally has a higher type II error rate than Tukey's for all pairwise comparisons.

Alpha= 0.05 Confidence= 0.95 df= 29 MSE= 2.200848
Critical Value of T= 2.83155

Comparisons significant at the 0.05 level are indicated by '***'.

HGNFSYDC Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
3 - 2	-2.9193	1.5714	6.0621	
3 - 1	-2.8305	1.6250	6.0805	
3 - 5	-0.8519	3.4706	7.7931	
2 - 3	-6.0621	-1.5714	2.9193	
2 - 1	-2.1205	0.0536	2.2276	
2 - 5	0.0127	1.8992	3.7856	***
1 - 3	-6.0805	-1.6250	2.8305	
1 - 2	-2.2276	-0.0536	2.1205	
1 - 5	0.0446	1.8456	3.6466	***
5 - 3	-7.7931	-3.4706	0.8519	
5 - 2	-3.7856	-1.8992	-0.0127	***
5 - 1	-3.6466	-1.8456	-0.0446	***

Analysis of Variance Procedure

Scheffe's test for variable: BCDGNFSY

NOTE: This test controls the type I experimentwise error rate but generally has a higher type II error rate than Tukey's for all pairwise comparisons.

Alpha= 0.05 Confidence= 0.95 df= 29 MSE= 2.200848
Critical Value of F= 2.93403

Comparisons significant at the 0.05 level are indicated by '***'.

HGNFSYDC Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
3	- 2	-3.1338	1.5714	6.2767
3	- 1	-3.0434	1.6250	6.2934
3	- 5	-1.0584	3.4706	7.9996
2	- 3	-6.2767	-1.5714	3.1338
2	- 1	-2.2244	0.0536	2.3315
2	- 5	-0.0774	1.8992	3.8758
1	- 3	-6.2934	-1.6250	3.0434
1	- 2	-2.3315	-0.0536	2.2244
1	- 5	-0.0415	1.8456	3.7327
5	- 3	-7.9996	-3.4706	1.0584
5	- 2	-3.8758	-1.8992	0.0774
5	- 1	-3.7327	-1.8456	0.0415

Appendix F: Frequency Tables for Questions 12 to 17

TABLE 1

JOB CHARACTERISTICS

Question	Frequency	Percentage
12. Bachelor's degree essential		
Very Inaccurate	3	9.1
Mostly Inaccurate	6	18.2
Slightly Inaccurate	5	15.2
Uncertain	2	6.1
Slightly Accurate	3	9.1
Mostly Accurate	11	33.3
Very Accurate	3	9.1
	33	100.0
13. Bachelor's degree in IS essential		
Very Inaccurate	2	6.1
Mostly Inaccurate	4	12.1
Slightly Inaccurate	4	12.1
Uncertain	3	9.1
Slightly Accurate	9	27.3
Mostly Accurate	8	24.2
Very Accurate	3	9.1
	33	100.0
14. Graduate diploma essential		
Very Inaccurate	6	18.2
Mostly Inaccurate	9	27.3
Slightly Inaccurate	6	18.2
Uncertain	3	9.1
Slightly Accurate	6	18.2
Mostly Accurate	3	9.1
Very Accurate	0	.0
	33	100.0

Table 1 (Cont)

Question	Frequency	Percentage
15. Graduate diploma in IS essential		
Very Inaccurate	2	6.1
Mostly Inaccurate	5	15.2
Slightly Inaccurate	8	24.2
Uncertain	1	3.0
Slightly Accurate	6	18.2
Mostly Accurate	8	24.2
Very Accurate	3	9.1
	33	100.0
16. Master's degree essential		
Very Inaccurate	22	66.7
Mostly Inaccurate	6	18.2
Slightly Inaccurate	1	3.0
Uncertain	3	9.1
Slightly Accurate	0	.0
Mostly Accurate	1	3.0
Very Accurate	0	.0
	33	100.0
17. Master's degree in IS essential		
Very Inaccurate	16	48.5
Mostly Inaccurate	6	18.2
Slightly Inaccurate	1	3.0
Uncertain	4	12.1
Slightly Accurate	4	12.1
Mostly Accurate	1	3.0
Very Accurate	1	3.0
	33	100.0

Appendix G: Frequency Tables for Questions 18 to 37

TABLE 1

KNOWLEDGE, SKILLS, AND ABILITIES

Question	Frequency	Percentage
18. Information Gathering Techniques		
Not Useful	1	3.0
Somewhat Useful	4	12.1
Useful	8	24.2
Very Useful	10	30.3
Essential	10	30.3
	33	100.0
19. System Design Techniques		
Not Useful	2	6.1
Somewhat Useful	6	18.2
Useful	8	24.2
Very Useful	14	42.4
Essential	3	9.1
	33	100.0
20. File Design		
Not Useful	17	51.5
Somewhat Useful	2	6.1
Useful	9	27.3
Very Useful	5	15.2
Essential	0	.0
	33	100.0

Table 1 (Cont)

Question	Frequency	Percentage
21. Planning and Control of System Projects		
Not Useful	3	9.1
Somewhat Useful	3	9.1
Useful	6	18.2
Very Useful	8	24.2
Essential	13	39.4
	33	100.0
22. Human Relations in Systems Development		
Not Useful	2	6.1
Somewhat Useful	3	9.1
Useful	12	36.4
Very Useful	14	42.4
Essential	2	6.1
	33	100.0
23. Human Factors in Equipment Design and Work Layout		
Not Useful	6	18.2
Somewhat Useful	11	33.3
Useful	9	27.3
Very Useful	6	18.2
Essential	1	3.0
	33	100.0
24. Introductory Computer and Information Systems Concepts		
Not Useful	0	.0
Somewhat Useful	2	6.1
Useful	5	15.2
Very Useful	4	12.1
Essential	22	66.7
	33	100.0

Table 1 (Cont)

Question	Frequency	Percentage
25. Application Programming Languages		
Not Useful	8	24.2
Somewhat Useful	15	45.5
Useful	6	18.2
Very Useful	4	12.1
Essential	0	.0
	33	100.0
26. Job Control Language		
Not Useful	16	48.5
Somewhat Useful	14	42.4
Useful	3	9.1
Very Useful	0	.0
Essential	0	.0
	33	100.0
27. Database Management Systems		
Not Useful	0	.0
Somewhat Useful	7	21.2
Useful	13	39.4
Very Useful	7	21.2
Essential	6	18.2
	33	100.0
28. Operating Systems		
Not Useful	0	.0
Somewhat Useful	7	21.2
Useful	12	36.4
Very Useful	8	24.2
Essential	6	18.2
	33	100.0

Table 1 (Cont)

Question	Frequency	Percentage
29. Mainframe Hardware		
Not Useful	5	15.2
Somewhat Useful	10	30.3
Useful	10	30.3
Very Useful	7	21.2
Essential	1	3.0
	33	100.0
30. Micro/Minicomputer Hardware		
Not Useful	0	.0
Somewhat Useful	5	15.2
Useful	10	30.3
Very Useful	10	30.3
Essential	8	24.2
	33	100.0
31. Telecommunications Concepts		
Not Useful	2	6.1
Somewhat Useful	4	12.1
Useful	6	18.2
Very Useful	17	51.5
Essential	4	12.1
	33	100.0
32. Computer Security Controls and Auditing		
Not Useful	0	.0
Somewhat Useful	5	15.2
Useful	7	21.2
Very Useful	17	51.5
Essential	4	12.1
	33	100.0

Table 1 (Cont)

Question	Frequency	Percentage
33. Software Package Analysis		
Not Useful	3	9.1
Somewhat Useful	5	15.2
Useful	15	45.5
Very Useful	7	21.2
Essential	3	9.1
	33	100.0
34. Computer Operations		
Not Useful	1	3.0
Somewhat Useful	4	12.1
Useful	7	21.2
Very Useful	17	51.5
Essential	4	12.1
	33	100.0
35. Legal Aspects of Computing		
Not Useful	6	18.2
Somewhat Useful	6	18.2
Useful	12	36.4
Very Useful	8	24.2
Essential	1	3.0
	33	100.0
36. Computer Simulation		
Not Useful	13	39.4
Somewhat Useful	12	36.4
Useful	4	12.1
Very Useful	4	12.1
Essential	0	.0
	33	100.0

Table 1 (Cont)

Question	Frequency	Percentage
37. Statistical Decision Theory		
Not Useful	14	42.4
Somewhat Useful	13	39.4
Useful	4	12.1
Very Useful	2	6.1
Essential	0	.0
	33	100.0

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Vita

Flight Lieutenant Ralph G.L. Kettle was born on 23 November 1962 in London, England. He graduated from Marist College, Pearce in 1980. In January 1981 he joined the RAAF as a Diploma Cadet 2 and attended the Darling Downs Institute of Advanced Education. In December 1983 he received a Bachelor's Degree in Business Studies (Computing) and was subsequently commissioned as an Equipment Officer in the RAAF. Flight Lieutenant Kettle has served as: a Supernumerary at Base Squadron Richmond; Equipment Officer/Catering Officer at RAAF Support Unit Glenbrook; Systems Analysis Officer, and Support Officer 2 at No 7 Stores Depot; Officer in Charge of Warehousing, and Warehousing Officer at No 2 Stores Depot; and Logistics Policy 2D1, and Logistics Policy 1C at the Department of Defence (Air Force Office). In June 1992 he entered the Graduate School of Logistics and Acquisition Management as a student in Information Resource Management. Flight Lieutenant Kettle is married to the former Sharon Frazer of Melbourne, Australia and they have two children: Christopher (3 1/2) and Joshua (2 days).

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Vita

Flight Lieutenant Joseph Ross Taylor was born on 7 March 1961 in Ayr, Queensland, Australia. He matriculated from All Souls and St. Gabriel's School in Charters Towers, Queensland in 1978. He attended Capricornia Institute of Advanced Education in Rockhampton, Queensland, graduating in 1982 with a Bachelor of Business, majoring in management and data processing. After graduation, he worked for three years in private industry. In February, 1986, he was commissioned as a Supply Officer in the Royal Australian Air Force. After attending Officer Training School, he was posted to Base Squadron Amberley, Queensland as the Procurement Officer and later served as the Assistant Facilities Officer. In December 1988, he was posted to Supply Support Squadron Williamtown, New South Wales as the Warehousing Officer and later served as the Movements Officer. In May 1992, Flight Lieutenant Taylor entered the Information Resource Management program at the Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology. Flight Lieutenant Taylor is married to Melissa nee Judas of Rockhampton.

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13. ABSTRACT *(Maximum 200 words)*

This study assessed the appropriateness, to the Royal Australian Air Force (RAAF), of a graduate professional program in Information Systems (IS) based on the Association for Computing Machinery's (ACM) curriculum model. The ACM curriculum model is an archetype of graduate education in IS. Programs based on this model produce graduates with knowledge, skills, and abilities (KSAs) that are required by IS practitioners. The usefulness of twenty KSAs that underlie the ACM curriculum model were evaluated by 33 incumbents of RAAF Information Systems Agencies and Directorate of Communications and Information Systems - Air Force. Although uncertain about the educational background suited to their job requirements, the respondents found 17 of the KSAs at least somewhat useful, indicating that education based on the ACM curriculum model is appropriate. Recommendations include: developing a RAAF IS education strategy based on the KSAs, promoting the benefits of IS education, using graduate diplomas in IS as an effective and efficient means of obtaining the necessary KSAs, and examining RAAF sponsored bachelor degrees in IS to ensure that appropriate KSAs are being provided. Future research should identify graduate diploma programs that provide the relevant KSAs presented.

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